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Project Manual

Van Buren Charter Township
The Lakeside Park
Belleville Road
Van Buren Township, Michigan

Project No. 2500281

Issued for Bids and Permits

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PROJECT MANUAL
FOR
VAN BUREN CHARTER TOWNSHIP

THE LAKESIDE PARK
BELLEVILLE ROAD
VAN BUREN TOWNSHIP, MICHIGAN 48111

October 12, 2026
Project Number 2500281

CONSTRUCTION MANAGER / ARCHITECT / ENGINEER

FISHBECK
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SECTION 00 11 13 - ADVERTISEMENT FOR BIDS

Van Buren Charter Township

The Lakeside Park

1. RECEIPT OF BIDS

Fishbeck is the Construction Manager for The Lakeside Park. Sealed Bids will be received until Wednesday, November 4, 2026, 10 a.m., local time. No Bids will be received after that time. Bids will be opened publicly and read aloud.

Bids are to be sent to:

Van Buren Township Offices - Lakeside Park Project
ATTENTION: Fishbeck/Chad Everts
46425 Tyler Road
Van Buren Township, MI 48111

Label Envelope:
Bid for: The Lakeside Park
Bid Category [ ]

2. SCOPE OF PROJECT

The Project including all Bid categories is for the construction of The Lakeside Park.

This Project will include the following bid categories:
BID CATEGORY 03-100 - Concrete
BID CATEGORY 04-100 - Masonry
BID CATEGORY 05-100 - Structural Steel and Miscellaneous Metals
BID CATEGORY 05-200 - Canopy/Skyring Installation (Owner has Pre-selected ICON/webuildfun)
BID CATEGORY 06-100 - General Trades
BID CATEGORY 07-100 - Roofing
BID CATEGORY 08-100 - Storefronts and Glazing
BID CATEGORY 09-100 - Painting
BID CATEGORY 09-300 – Flooring and Tile
BID CATEGORY 21-100 - Fire Suppression
BID CATEGORY 23-100 - Plumbing, Heating, Ventilation, and Air Conditioning
BID CATEGORY 26-100 – Electrical, Fire Alarm, and Audio/Visual
BID CATEGORY 31-100 – Earthwork, Site Utilities
BID CATEGORY 32-100 - Landscaping
BID CATEGORY 35-100 – Boardwalk, Boat Docks, and Fishing Pier

See Summary of Work for detailed explanation of bid categories.

3. FINANCING

The Project will be financed with local funds.

4. ISSUING OFFICE

Bidding Documents are being issued from Fishbeck's Grand Rapids office. Bidders should direct questions and correspondence to Chad Everts at creverts@fishbeck.com.

5. EXAMINATION OF DOCUMENTS

Bidding Documents may be examined at the following locations after Monday, October 12, 2026, 5 p.m., local time.

Construction Association of Michigan (CAM): Bloomfield Hills.

The Plan Room: Ann Arbor.

6. OBTAIN BIDDING DOCUMENTS

Bidding Documents may be obtained by emailing Chad Everts – Project Manager at creverts@fishbeck.com to be placed on the bidders list and to obtain an electronic copy of the bidding documents.

7. WITHDRAWAL OF BIDS

Bids may not be withdrawn for a period of 60 days after the actual date of opening thereof. This time period may be extended by mutual agreement of the Construction Manager and any Bidder or Bidders.

8. RIGHT TO REJECT BIDS

The Construction Manager reserves the right to waive any irregularities and to reject any and all Bids.

9. PREBID CONFERENCE

A prebid conference will be held on Wednesday, October 21, 2026, 10 a.m., local time at Black Box Theater, Van Buren Community Center, 46425 Tyler Road, Van Buren Township, Michigan 48111. Prospective Bidders are encouraged to attend and participate in the conference, but attendance is not mandatory.

10. ON-SITE LABOR

Owner requires that all on-site construction labor be performed by a unionized labor force.

END OF SECTION 00 11 13

SECTION 00 21 13 - INSTRUCTIONS TO BIDDERS

ARTICLE 1 - DEFINED TERMS

1.01 Terms used in these Instructions to Bidders will have the meanings indicated below which are applicable to both the singular and plural thereof:

A. Addenda - Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

B. Agreement - The written instrument which is evidence of the agreement between Construction Manager and Subcontractor covering the Work.

C. Bid - The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

D. Bidder - The individual or entity who submits a Bid directly to the Construction Manager.

E. Bidding Documents - The Bidding Requirements and the proposed Contract Documents (including all Addenda).

F. Bidding Requirements - The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

G. Issuing office – the office identified in the Advertisement for Bids, from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

H. Laws and Regulations; Laws or Regulations - Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

I. Site - Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Construction Manager.

J. Work - The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

ARTICLE 2 - COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents may be obtained as indicated in the Advertisement for Bids. If a deposit is identified as being refundable, the deposit will be refunded to each document holder of record who returns a complete set of Bidding Documents in good condition within 30 days after opening of Bids.

2.02 Complete sets of Bidding Documents must be used in preparing Bids; Construction Manager assumes no responsibility for errors or misinterpretation resulting from the use of incomplete sets of Bidding Documents.

2.03 Construction Manager, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids on the Work and do not authorize or confer a license or grant for any other use.

ARTICLE 3 - QUALIFICATIONS OF BIDDERS

3.01 Each Bid shall contain evidence of Bidder's qualification to do business in the state where the Project is located or Bidder must covenant to obtain such qualification prior to award of the Contract.

3.02 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

3.03 To demonstrate Bidder's qualifications to perform the Work, within 5 days of Construction Manager's request, Bidder shall submit written evidence of:

A. Financial data, previous experience, present commitments, workers' compensation experience modification rating (EMR) and other such data as may be requested by Construction Manager.

B. Previous experience in constructing at least 3 projects of a similar type, comparable size and comparable complexity within the past 5 years.

3.04 When so requested, Bidder shall meet with Construction Manager and give further information in order to determine Bidder's qualifications, responsibility, and ability to perform and complete the Work in accordance with the Contract Documents.

3.05 Construction Manager reserves the right to reject any Bid if the evidence submitted by, or investigation of, a Bidder fails to satisfy Construction Manager that the Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein.

ARTICLE 4 - EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01 Subsurface and Physical Conditions

A. The following reports of explorations and tests of subsurface conditions at or contiguous to the Site are known to Owner/Construction Manager:

1. Report dated May 7, 2025, prepared by G2 entitled: Report on Geotechnical Investigation – Proposed Lake House Facility consisting of 30 pages. The "technical data" contained in such report upon which Subcontractor may rely is the soil boring logs at the locations and for the conditions at the time the soil borings were taken. This report has been included in the Section entitled Geotechnical Data.

2. Report dated July 24, 2026, prepared by G2 entitled: Report on Geotechnical Investigation – Lakeside Park (Proposed Lake House Facility) consisting of 24 pages. The "technical data" contained in such report upon which Subcontractor may rely is the soil boring logs at the locations and for the conditions at the time the soil borings were taken. This report has been included in the Section entitled Geotechnical Data.

B. Copies of reports and drawings referenced in Paragraph 4.01.A are included within this project manual for reference. Those reports and drawings are not part of the Contract Documents, but Bidders may rely upon the "technical data" contained therein. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 Underground Facilities

A. Information and data indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are based upon information and data furnished to Owner, Construction Manager, and Engineer by owners of such Underground Facilities, including Owner, or others.

4.03 Hazardous Environmental Condition

A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner/Construction Manager.

4.04 Provisions concerning responsibilities for the adequacy of data, if any, furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, Underground Facilities, and Hazardous Environmental Conditions, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Article 7.3 of the Agreement.

4.05 On request, Construction Manager will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.

4.06 Reference is made to the Division 01 Section "Summary of Work," for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime Subcontractors) that relates to the Work contemplated by these Bidding Documents. On request, Construction Manager will provide to each Bidder for examination access to or copies of contract documents, if any, (other than portions thereof related to price) for such other work.

4.07 Reference is made to the Division 1 Section "Summary of Work," for Owner/Construction Manager site safety and security requirements.

4.08 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;

B. visit the Site and become familiar with and satisfy Bidder as to the general, local and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy Bidder as to all federal, state and local Laws and Regulations that may affect cost, progress, or performance of the Work;

D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified.

E. consider the information known to Bidder; information commonly known to Subcontractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;

F. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

G. become aware of the general nature of the work to be performed by Owner/ Construction Manager and others at the Site that relates to the Work as indicated in the Bidding Documents;

H. promptly give Construction Manager written notice of all conflicts, errors, ambiguities or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Construction Manager is acceptable to Bidder; and

I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.09 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Construction Manager written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Construction Manager are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 - PREBID CONFERENCE

5.01 A Prebid Conference will be held on Wednesday, October 21, 2026 at 10 a.m., local time at Black Box Theater, Van Buren Community Center, 46425 Tyler Road, Van Buren Township, Michigan 48111. Representatives of Owner, Construction Manager and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference, but attendance is not mandatory. Construction Manager will transmit to all prospective Bidders of record such Addenda as Construction Manager considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 6 - SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Bidder.

ARTICLE 7 - INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be directed to Construction Manager in writing. Interpretations or clarification considered necessary by Construction Manager in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Construction Manager as having received the Bidding Documents. Questions received less than 5 days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Construction Manager.

ARTICLE 8 - BID SECURITY (NOT APPLICABLE)

ARTICLE 9 - CONTRACT TIMES

9.01 Bidder agrees that the work will be substantially complete on or before the dates shown on the construction schedule in Division 01 Section “Summary of Work”.

ARTICLE 10 - LIQUIDATED DAMAGES (NOT APPLICABLE)

ARTICLE 11 - SUBSTITUTE AND "OR EQUAL" ITEMS

11.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or equal" items.

11.02 Whenever materials or equipment are specified or described in the Bidding Documents by using the name of one or more Suppliers, the Bid shall be based on providing the materials or equipment of one of the Suppliers named.

11.03 Whenever it is specified or described in the Bidding Documents that a substitute or "or equal" item of material or equipment may be furnished or used by Bidder if acceptable to Architect/Engineer, application for such acceptance will not be considered by Architect/Engineer until after the Effective Date of the Agreement. The procedure for submission of any such application by Bidder and consideration by Architect/Engineer is set forth in Division 01 Section "Product Substitution" Procedures.

ARTICLE 12 - SUBCONTRACTORS, SUPPLIERS AND OTHERS

12.01 If Construction Manager requests, the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Construction Manager in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within 5 days after Bid opening, submit to Construction Manager a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualifications for each such Subcontractor, Supplier, individual or entity if requested by Construction Manager. If Construction Manager, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Construction Manager may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case the apparent Successful Bidder shall submit an acceptable substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Construction Manager may consider such price adjustment in evaluating Bids and making the Contract award.

12.02 If apparent Successful Bidder declines to make any such substitution, Construction Manager may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Construction Manager makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Construction Manager subject to revocation of such acceptance after the Effective Date of the Agreement.

12.03 Subcontractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Subcontractor has reasonable objection.

ARTICLE 13 - PREPARATION OF BID

13.01 The Bid form is included with the Bidding Documents. Additional copies may be obtained from Construction Manager.

13.02 All blanks on the Bid form shall be completed by printing in ink or by typewriter and the Bid signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid form. A Bid price shall be indicated for each Bid item listed therein. In the case of optional alternatives the words "No Bid", "No Change", or "Not Applicable" may be entered.

13.03 A Bid by a corporation shall be executed in the corporate name by the president, vice president, or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed, if required by state law, and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be indicated below the signature.

13.04 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be indicated below the signature.

13.05 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be indicated below the signature.

13.06 A Bid by an individual shall indicate the Bidder's name and official address.

13.07 A Bid by a joint venture shall be executed by each joint venture in the manner indicated on the Bid form. The official address of the joint venture shall be indicated below the signature.

13.08 All names shall be typed or printed in ink below the signatures.

13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid form.

13.10 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be indicated.

13.11 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state Subcontractor license number for the state the Project, if any, shall also be indicated on the Bid form.

ARTICLE 14 - BASIS OF BID; COMPARISON OF BIDS

14.01 Basis of Bid

A. Bidders shall submit a Bid on a stipulated (lump) sum basis for the base Bid as set forth in the Bid form.

14.02 The Bid price shall include such amounts as the Bidder deems proper for Subcontractor's overhead, costs, profit and other expenses on account of cash allowances, if any, named in the Contract Documents.

14.03 Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.

ARTICLE 15 - SUBMITTAL OF BID

15.01 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement for Bids and shall be enclosed in an opaque, sealed package, plainly marked with the Project title and name and address of the Bidder. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED".

ARTICLE 16 - MODIFICATION AND WITHDRAWAL OF BIDS

16.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.

16.02 If, within 24 hours after Bids are opened, any Bidder files a duly signed, written notice with Construction Manager and promptly thereafter demonstrates to the reasonable satisfaction of Construction Manager that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

16.03 No withdrawal of a Bid shall be permitted on account of mistake or any other reason after the expiration of this 24 hour period.

ARTICLE 17 - OPENING OF BIDS

17.01 Bids will be opened at the time and place indicated in the Advertisement for Bids and, unless obviously nonresponsive, read aloud publicly. An abstract of the amounts of the Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid form, but Construction Manager may, in its sole discretion, release any Bid prior to the end of this period.

ARTICLE 19 - AWARD OF CONTRACT

19.01 Construction Manager reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced or conditional Bids. Construction Manager further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible. Construction Manager may also reject the Bid of any Bidder if Construction Manager believes that it would not be in the best interest of the Project to make an award to that Bidder. Construction Manager also reserves the right to waive all informalities not involving price, time or changes in the Work and to negotiate contract terms with the Successful Bidder.

19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03 In evaluating Bids, Construction Manager will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data as may be requested in the Bid form or prior to the Notice of Award.

19.04 In evaluating Bidders, Construction Manager will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted.

19.05 Construction Manager also may consider the operating costs, maintenance considerations, performance data and guarantees of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

19.06 Construction Manager may conduct such investigations as Construction Manager deems necessary to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals or entities proposed for those portions of the Work in accordance with the Contract Documents.

19.07 If the Contract is to be awarded, Construction Manager will award the Contract to the Bidder whose Bid is in the best interests of the Project. Alternates will not be considered in the award of this Contract.

19.08 If the Contract is to be awarded, Construction Manager will give Successful Bidder a Notice of Award within 60 days after the day of the Bid opening.

ARTICLE 20 - CONTRACT INSURANCE AND BOND REQUIREMENTS

20.01 Insurance

A. Article 9.2 of the Agreement, sets forth Construction Manager's requirements as to insurance. When the Successful Bidder delivers the executed Agreement to Construction Manager, it shall be accompanied by the required certificates of insurance (and other evidence of insurance requested by Construction Manager).

20.02 Bonds

A. Article 9.3 of the Agreement, and Sections “Performance Bond” and “Payment Bond,” sets forth Construction Manager's requirements as to bonds. When Successful Bidder delivers the executed Agreement to Construction Manager, it shall be accompanied by the required bonds.

ARTICLE 21 - SIGNING OF AGREEMENT

21.01 When Construction Manager issues a Notice of Award electronically to the Successful Bidder, it will be accompanied by the Agreement with the Contract Documents which are identified in the Agreement as attached thereto. Within 15 days thereafter, Successful Bidder shall sign and electronically return the Agreement and attached documents to Construction Manager. Within 10 days thereafter, Construction Manager will electronically return one fully executed Agreement to Successful Bidder.

ARTICLE 22 - RETAINAGE AND PROGRESS PAYMENTS

22.01 Provisions concerning retainage and progress payments are set forth in the Agreement.

22.02 Retainages and progress payments will be in accordance with State of Michigan Act 524 of the Public Acts of 1980.

ARTICLE 23 – BID CATEGORIES

23.01 Refer to Division 01 Section “Summary of Work’ for bid category descriptions.

ARTICLE 24 – OWNER FURNISHED MATERIAL

24.01 Refer to Division 01 Section “Summary of Work” for Owner furnished materials.

ARTICLE 25 - WORK BY OWNER

25.01 Refer to Division 01 Section “Summary of Work” for work by Owner.

END OF SECTION 00 21 13

SECTION 00 31 32 – GEOTECHNICAL DATA

Beginning of Geotechnical Data

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REPORT ON GEOTECHNICAL INVESTIGATION

PROPOSED LAKE HOUSE FACILITY

BELLEVILLE ROAD AT QUIRK ROAD
VAN BUREN TOWNSHIP, MICHIGAN 48111

LATITUDE 42.2134325° N
LONGITUDE 83.4919705° W

CONSULTING GROUP

Prepared for:

Fishbeck
39500 MacKenzie Drive, Suite 100
Novi, Michigan 48377

G2 Project No. 250079
May 7, 2025

May 7, 2025

Mr. Eric Hansen, P.E.
Senior Civil Engineer
Fishbeck
39500 MacKenzie Drive, Suite 100
Novi, Michigan 48377

RE: Report on Geotechnical Investigation
Proposed Lake House Facility
Belleville Road at Quirk Road
Van Buren Township, Michigan 48111
G2 Project No. 250079

Dear Mr. Hansen:

We have completed the geotechnical investigation at the proposed Lake House Facility to be constructed south of the intersection of Belleville Road and Quirk Road within the Township of Van Buren, Michigan. This report presents the results of our observations and analysis and our recommendations for subgrade preparation, foundation construction, and construction considerations.

We appreciate the opportunity to be of service to Fishbeck and look forward to discussing the recommendations presented. In the meantime, if you have any questions regarding the report or any other matter pertaining to the project, please call us.

Sincerely,

G2 Consulting Group, LLC

Jeffrey M. Hayball, P.E.
Project Manager

Noel J. Hargrave-Thomas, P.E.
Principal

JMH/NJHT/ljv

EXECUTIVE SUMMARY

Approximately 3 to 12 inches of topsoil are present at the ground surface of the borings. Medium compact gravelly sand fill underlies the topsoil within boring B-01 and extends to 2-1/2 feet. Stiff silty clay fill with trace organic matter is present below the topsoil within boring B-11 and extends to 3 feet. Native stiff to hard silty clay is present below the fill within borings B-01 and B-11 and topsoil within the remaining borings, extending to the explored depths of 10 and 25 feet within borings B-01, B-02, and B-05 through B-07 and depths ranging from 20 to 21 feet within borings B-03, B-04, and B-08 through B-11. Native compact to very compact silty sand underlies the silty clay within borings B-03, B-04, and B-08 through B-11 and generally extends to the explored depths of 25 and 30 feet. Groundwater was encountered within borings B-03, B-04, B-08, B-09, and B-11 at depths ranging from 19-1/2 to 26 feet during drilling operations. Upon completion of drilling operations, groundwater was measured at depths ranging from 21 to 27 feet within borings B-03, B-04, B-08, B-09, and B-11. No measurable groundwater was observed within borings B-01, B-02, B-05 through B-07, and B-10 during or upon completion of drilling operations.

The silty clay fill present within the upper 3 feet of boring B-11 contains an organic matter content of 6.9 percent. The silty clay fill is not suitable for support of foundations, floor slabs, pavements, or engineered fill. Therefore, we recommend completely removing the silty clay fill within the vicinity of boring B-11 and replacing the resulting undercut excavation with engineered fill.

We recommend the proposed building be supported on conventional strip and spread footing foundations bearing on native stiff to very stiff silty clay or engineered fill placed over native soils. Foundation design should be based on an allowable bearing capacity of 3,000.

We recommend the proposed traffic signal poles be supported by 42-inch diameter drilled pier foundations in accordance with the following table per MDOT standards:

	Single Mast Arm Pole	
Soil Boring	Soil Type	Foundation Depth (feet)
B-01	High Clay	12.5
B-02	High Clay	11.5
B-03	High Clay	12.5
B-04	High Clay	12.5

Note: Due to the presence of collapsible soils, temporary casing will be required within drilled pier excavation at boring B-01.

High clay soil is defined as clay with a shear strength greater than or equal to 2,000 psf. Caving and sloughing of the granular fill soils within the upper 2-1/2 feet within boring B-01 may occur during drilled pier foundation excavations. Therefore, the contractor should come to the site prepared to use temporary steel casing, as necessary to maintain a stable excavation during construction operations.

We recommend a new bituminous concrete pavement section consisting of 2 inches of MDOT 5EML bituminous concrete wearing course, 2 inches of MDOT 4EML bituminous concrete leveling course, supported on a minimum of 8 inches of MDOT 21AA aggregate base. We recommend a new Portland cement concrete pavement section consisting of 6 inches of MDOT 3500 Portland cement concrete supported on a minimum of 8 inches of MDOT 21AA aggregate base.

Do not consider this summary separate from the entire text of this report, with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are discussed in the following sections and in the Appendix of this report.

PROJECT DESCRIPTION

We understand the project includes construction of a single-story, slab-on-grade structure with an approximate footprint of 11,970 square feet on the south side of the intersection of Belleville Road and Quirk Road within the Township of Van Buren, Michigan. The finished floor elevation for the proposed building is 669 feet. Pavements, retaining walls, and underground utilities will be constructed in conjunction with the project. In addition, new mast-arm traffic signals will be constructed at the four corners of the intersection of Belleville Road and Quirk Road. The mast-arm traffic signal to be constructed at the north corner of the intersection will consist of a 45 feet long single-arm traffic signal. The mast-arm traffic signal at the remaining three (3) locations will be constructed with a 55 feet long single-arm traffic signal.

Loading conditions were not available upon completion of this report. We anticipate loads for the single-story structure will be subject to wall loads ranging from 2 to 4 kips per linear foot and interior column loads ranging from 25 to 75 kips. When loading conditions become available, G2 should be notified so that we can review the recommendations provided within this investigation.

The purpose of our exploration is to determine and evaluate the general subsurface conditions at the site and to develop related foundation recommendations for the support of the proposed structure, mast-arm traffic signal foundations, pavement and floor slab design, retaining walls, site preparation, and construction considerations as they relate to the project.

SCOPE OF SERVICES

The field operations, laboratory testing, and engineering report preparation were performed under direction and supervision of a licensed professional engineer. Our services were performed according to generally accepted standards and procedures in the practice of geotechnical engineering in this area, MDOT Requirements for Preliminary Geotechnical Investigations for Signal Foundations, and Traffic Signal Mast Arm Pole Foundation Design Table SIG-DESIGN-284-A. Our scope of services for this project is as follows:

1. We drilled a total of eleven (11) soil borings, B-01 through B-11 for the project. Soil borings B-01 through B-04 were drilled at the four corners of the intersection of Belleville Road and Quirk Road, extending to a depth of 25 feet each. Soil borings B-05 through B-07 were performed within proposed pavement areas, extending to a depth of 10 feet below grade. Soil borings B-08 through B-11 were drilled within the footprint of the proposed building, extending to a depth of 30 feet each.

2. We performed laboratory testing on representative samples obtained from the soil borings. Laboratory testing included visual engineering classification, Atterberg Limits, natural moisture content, organic matter content (loss-on-ignition), dry density, and unconfined compressive strength determination.

3. We prepared this engineering report. The report includes recommendations regarding foundation types suitable for the soil conditions encountered, allowable bearing capacities of the anticipated bearing soil layers, estimated settlement, and construction considerations related to site preparation and foundation construction.

FIELD OPERATIONS

Fishbeck, in conjunction with G2, selected the depth and location of the soil borings. The boring locations were located in the field by Fishbeck using conventional surveying methods prior to our drilling operations. The approximate soil boring location is shown on the Soil Boring Location Plan, Plate No. 1. The ground surface elevation at each boring location was provided by Fishbeck.

The soil borings were drilled using an All-Terrain-Vehicle (ATV) and a truck-mounted rotary drilling rig. Continuous flight, 2-1/4-inch, inside diameter hollow-stem augers were used to advance the boreholes to the explored depths. Soil samples were obtained at intervals of 2-1/2 feet within borings B-01 through B-07 and at 2-1/2 feet intervals the upper

10 feet and at 5 foot intervals thereafter within borings B-08 through B-11. These samples were obtained by the Standard Penetration Test method (ASTM D 1586), which involves driving a 2-inch diameter split-spoon sampler into the soil with a 140-pound weight falling 30 inches. The sampler is generally driven three successive 6-inch increments with the number of blows for each increment recorded. The number of blows required to advance the sampler the last 12 inches is termed the Standard Penetration Resistance (N). Blow counts for each 6-inch increment and the resulting N-values are presented on the individual soil boring logs.

Soil samples were placed in sealed containers in the field and brought to our laboratory for testing and classification. During field operations, the drilling crew maintained logs of the encountered subsurface conditions, including changes in stratigraphy and observed groundwater levels. The final boring logs are based on the field logs supplemented by laboratory soil classification and test results. After completion of drilling operations, the boreholes were backfilled with auger cuttings.

LABORATORY TESTING

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to foundation and pavement design and construction. An experienced geotechnical engineer classified the samples in general conformance with the Unified Soil Classification System.

Laboratory testing included Atterberg Limits, natural moisture content, dry density, organic matter content (loss-on-ignition), and unconfined compressive strength determinations. Atterberg limits were determined in accordance with ASTM D 4318 "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils". The organic matter content of representative samples was determined in accordance with ASTM Test Method D 2974, "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils". The unconfined compressive strengths were determined by ASTM Test Method D2166 and using a spring-loaded hand penetrometer. Per ASTM D2166, the unconfined compressive strength of cohesive soils is determined by axially loading a small cylindrical soil sample under a slow rate of strain. The unconfined compressive strength is defined as the maximum stress applied to the soil sample before shear failure. If shear failure does not occur prior to a total strain of 15 percent, the unconfined compressive strength is defined as the stress at a strain of 15 percent. The hand penetrometer estimates the unconfined compressive strength to a maximum of 4-1/2 tons per square foot (tsf) by measuring the resistance of the soil sample to the penetration of a calibrated spring-loaded cylinder.

The results of the moisture content, organic matter content, dry density, and unconfined compressive strength laboratory tests are indicated on the soil boring logs at the depths the samples were obtained. Unconfined Compressive Strength Test are shown graphically on Figure No. 12 within the Appendix. Atterberg limits are shown graphically on Figure No. 13 in the Appendix. We will hold the soil samples for 60 days from the date of this report. If you would like the samples, please let us know.

SITE DESCRIPTION

The proposed site is located on the south side of Belleville Road at Quirk Road. The site is currently a heavily wooded area. Site grades at the soil boring locations range in elevation from approximately 663 to 675 feet. Site grades generally are sloped to Belleville Lake, which bounds the property to the south. Belleville Road bounds the property to the north. Surrounding properties are generally residential in nature.

SOIL CONDITIONS

Proposed Mast-Arm Traffic Signals (Borings B-01 through B-04)

Approximately 4 to 11 inches of topsoil are present at the ground surface of the borings. Gravelly sand fill underlies the topsoil within boring B-01 and extends to an approximate depth of 2-1/2 feet. Native silty clay is present below the

gravelly sand fill within boring B-01 and topsoil within borings B-02 through B-04, extending to the explored depth of 25 feet within borings B-01 and B-02 and depths ranging from 20 to 21 feet within borings B-03 and B-04. Native silty sand underlies the silty clay within borings B-03 and B-04 and extends to the explored depth of 25 feet.

The gravelly sand fill is medium compact with a Standard Penetration Test (SPT) N-value of 15 blows per foot (bpf). The native silty clay is very stiff to hard in consistency with natural moisture contents ranging from 10 to 23 percent and unconfined compressive strengths ranging from 4,000 to 9,000 pounds per square feet (psf). The native silty sand is compact with SPT N-values ranging from 35 to 41 bpf.

Proposed Lake House Facility and Pavement Areas (Borings B-05 through B-11)

Approximately 3 to 12 inches of topsoil are present at the ground surface of the borings. Silty clay fill with trace organic matter underlies the topsoil within boring B-11 and extends to an approximate depth of 3 feet. Native silty clay is present below the silty clay fill within boring B-11 and topsoil within borings B-05 through B-10, extending to the explored depth of 10 feet within borings B-05 through B-07 and depths ranging from 23 to 26 feet within borings B-08 through B-11. Native silty sand underlies the silty clay within borings B-08 through B-11 and generally extends to the explored depth of 30 feet. However, native silty clay is present below the native silty sand within boring B-10 at an approximate depth of 26 feet and extends to the explored depth of 30 feet.

The silty clay fill is stiff in consistency with a moisture content of 37 percent, an organic matter content of 6.9 percent, and an unconfined compressive strength of 2,500 psf.. The native silty clay is stiff to hard in consistency with natural moisture contents ranging from 9 to 20 percent, a liquid limit of 35 percent, a plasticity index of 17 percent, a dry density of 103 pound per cubic foot (pcf), and unconfined compressive strengths ranging from 2,730 to 9,000 pounds per square feet (psf). The native silty sand is compact to very compact with SPT N-values ranging from 36 to 53 bpf.

General

The stratification depths shown on the soil boring logs represent the soil conditions at the boring locations. Variations may occur away from the boring locations. Additionally, the stratigraphic lines represent the approximate boundaries between soil types. The transition may be more gradual than indicated. We have prepared the boring logs on the basis of the field logs of the soil conditions encountered supplemented by laboratory classification and testing.

The Soil Boring Location Plan, Plate No. 1, Soil Boring Logs, Figure Nos. 1 through 11, Unconfined Compressive Strength Test, Figure No. 12, and Atterberg Limits Results, Figure No. 13, are presented in the Appendix. The soil profiles described above are generalized descriptions of the conditions encountered at the boring locations. General Notes Terminology defining the nomenclature used on the soil boring logs and elsewhere in this report are presented on Figure No. 14.

GROUNDWATER CONDITIONS

Groundwater observations were documented during and upon completion of drilling operations. Groundwater was encountered within borings B-03, B-04, B-08, B-09, and B-11 at depths ranging from 19-1/2 to 26 feet during drilling operations. Upon completion of drilling operations, groundwater was measured at depths ranging from 21 to 27 feet within borings B-03, B-04, B-08, B-09, and B-11. No measurable groundwater was observed within borings B-01, B-02, B-05 through B-07, and B-10 during or upon completion of drilling operations.

Fluctuations in perched and long term groundwater levels should be anticipated due to seasonal variations and following periods of prolonged precipitation. It should also be noted that groundwater observations made during drilling operations in predominantly cohesive soils are not necessarily indicative of the static groundwater level. This is due to the low permeability of such soils and the tendency of drilling operations to seal off the natural paths of groundwater flow.

SITE SEISMICITY

Wayne County lies in a stable tectonic region of the country characterized by a relatively low expected magnitude of ground accelerations during an earthquake event. The observed soils at the site generally consist of stiff to hard silty clay extending to depths on the order of 23 to 26 feet overlying compact to very compact silty sand. Groundwater is present at depths as shallow as 19-1/2 feet. Based on the subsurface soil conditions, we recommend a Seismic Site Classification of D, Stiff Soil Profile, and the following seismic design parameters per IBC 2015 Risk Level II.

Spectral Response Category	Response Acceleration at Short Periods	Response Acceleration at One Second Period
Maximum Considered Earthquake	S_S = 0.099 g	S_1 = 0.048 g
Adjusted Maximum Considered Earthquake	S_{MS} = 0.158 g	S_{M1} = 0.116 g
Five Percent Damped Design	S_{DS} = 0.105 g	S_{D1} = 0.077 g

Given the soils conditions are generally cohesive and the site in an area with a low probability of occurrence for seismic activity, we believe the risk for liquefaction at this site is low.

SITE PREPARATION

The finished floor elevation for the proposed building is 669 feet. Ground surface elevations at the soil borings performed within the footprint of the proposed building range in elevation from 663 to 665-1/2 feet. Therefore, after topsoil removal, we estimate up to 6 feet of engineered fill will be required to achieve final grades. The silty clay fill present within the upper 3 feet of boring B-11 contains an organic matter content of 6.9 percent. The silty clay fill is not suitable for support of foundations, floor slabs, pavements, or engineered fill. Therefore, we recommend completely removing the silty clay fill within the vicinity of boring B-11 and replacing the resulting undercut excavation with engineered fill.

Earthwork operations are anticipated to consist of removing any existing topsoil, undercutting the silty clay fill within the vicinity of boring B-11, backfilling the undercut excavation with engineered fill, proof rolling the generally cohesive subgrade soils prior to placing any engineered fill, placing engineered fill to raise site grades, excavating for foundations of the proposed building and mast-arm traffic signals, excavating for new underground utilities, backfilling newly installed underground utilities with engineered fill, constructing the proposed retaining walls, and preparing the subgrade for support of floor slab and pavements. We recommend all earthwork operations be performed in accordance with comprehensive specifications and be properly monitored in the field by G2 geotechnical engineers or technicians under the direction of a licensed professional engineer.

At the start of the earthwork operations, any topsoil, vegetation, and trees must be completely removed in their entirety from within the footprint of the proposed building and associated pavement areas. Following removal of the surficial topsoil, and vegetation and prior to placement of engineered fill, the exposed cohesive subgrade should be proof rolled with a fully loaded dump truck and evaluated for stability by a qualified geotechnical engineer any areas that are unstable should be removed and replaced with engineered fill.

Engineered fill should be free of organic matter, frozen soil, clods, or other harmful material. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade. Engineered fill should be placed in uniform horizontal layers, not more than 9 inches in loose thickness. The engineered fill should be compacted to achieve a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction test (ASTM D 1557). Any cohesive engineered fill material should be placed and compacted at moisture contents within 3 percent above

and 1 percent below the moisture content. Any granular engineered fill material should be placed and compacted at moisture contents within 2 percent above or below the optimum moisture content.

We recommend using an imported granular engineered fill within confined areas such as adjacent to foundation walls or utility trenches. Granular engineered fill is generally more easily compacted than cohesive soils within these confined areas. Additionally, the proper placement and compaction of backfill within these areas is imperative to provide adequate support for overlying floor slabs and pavements.

NEW BUILDING FOUNDATION RECOMMENDATIONS

We anticipate up to 6 feet of engineered fill will be required to achieve final grades within the proposed building. Based upon the existing subgrade conditions and anticipated loading conditions, we recommend the proposed building be supported on conventional strip and spread footing foundations. We anticipate foundations will bear within engineered fill placed atop of native stiff to very stiff silty clay.

We recommend a net allowable bearing pressure of 3,000 psf be used for design of foundations bearing on native soils or on engineered fill placed over the native stiff to very stiff silty clay. Exterior foundations should bear at a minimum depth of 3-1/2 feet below finished grade for protection against frost heave. Interior foundations may bear at shallower depths provided suitable bearing soils are present and foundations are protected from frost penetration during construction operations. A G2 engineer should be on site during construction to observe the excavations, measure the bearing depths, and verify the adequacy of the bearing soils.

Continuous wall or strip footings should be at least 12 inches in width and isolated spread footings should be at least 30 inches in their least dimension. To achieve a change in the level of the strip footings, the footings should be gradually stepped at a grade no steeper than two units horizontal to one unit vertical. We recommend all strip footings be suitably reinforced to minimize the effects of differential settlements associated with local variations in subsoil conditions.

If the recommendations outlined in this report are adhered to, total and differential settlements for the completed structure should be within 1 inch and 1/2 inch, respectively. We expect settlements of these magnitudes are within tolerable limits for the type of structure proposed.

BUILDING FLOOR SLAB RECOMMENDATIONS

We anticipate the floor slab for the proposed building will be constructed on engineering fill placed over native stiff to very stiff silty clay that pass the proof-roll evaluation as described in the SITE PREPARATION section of this report which are suitable to support the proposed floor slab. A subgrade modulus of 125 pci be used for floor slabs supported by engineered fill overlying native soils.

We recommend at least 4 inches of clean coarse sand or pea gravel be placed between the subgrade and the bottom of the floor slab for use as a capillary break to reduce moisture transmission through the concrete floors and to reduce the potential for concrete curling. If moisture sensitive floor coverings are planned or if greater protection against vapor transmission is desired, a vapor barrier consisting of 10-mil plastic sheeting, or equivalent, may be placed on the sand layer beneath floor slabs. However, additional floor slab curing techniques will be required if a vapor barrier is used. The floor slab should be isolated from the foundation system to allow for independent movement.

PAVEMENT RECOMMENDATIONS

We understand that pavement areas will consist of new bituminous concrete pavement and Portland cement concrete pavements. Subgrade soils are expected to consist of native silty clay and engineered fill placed to raise grades. These soils should be suitable for support of proposed pavements following satisfactory completion of subgrade preparation operations as described in the Site Preparation section of this report. In general, cohesive soils are generally considered

to be of poor quality for the direct support of conventional pavement structures, has poor drainage characteristics, and are considered to be highly susceptible to frost penetration.

We performed pavement design analyses in accordance with the "AASHTO Guide for Design of Pavement Structures". The subgrade soils will generally consist of native silty clay with moisture contents generally at or below the plastic limit or engineering fill placed over the native silty clay to raise grades. Based on the existing fill with trace organic matter, we recommend the subgrade soils be assigned an effective roadbed modulus of 6,000 pounds per square inch (psi) and an effective modulus of subgrade reaction, k, of 50 pounds per cubic inch (pci) for use in pavement design.

No information regarding anticipated traffic volumes was made available upon completion of this report. We assume the pavement areas will service primarily car traffic with the occasional delivery and garbage truck. Therefore, for evaluation purposes, we have designed the pavement section on an estimated of 50,000 ESALs over a 20-year design life. Once actual traffic loading information becomes available, G2 must be notified so that we may review our design assumptions.

For the proposed new pavement section, we estimated a serviceability loss of 2.0, a standard deviation of 0.39 for rigid pavements, a standard deviation of 0.49 for flexible pavements, a reliability factor of 0.95, load transfer coefficient of 3.2, a drainage coefficient of 1.0, a Portland cement concrete modulus of rupture of 670 psi, and an elastic modulus of the Portland cement concrete slab of 4,200,000 psi. Based on the results of our analysis and construction consideration, we recommend the minimum following pavement design cross-sections:

Flexible Pavement Section		
Material	**Thickness**	**Structural Coefficient**
MDOT 5EML Bituminous Wearing Course	2 inches	0.42
MDOT 4EML Bituminous Leveling Course (two equal lifts)	2 inches	0.42
MDOT 21AA Limestone Dense-Graded Aggregate	8 inches	0.14
	Structural Number	2.80

Rigid Pavement Section	
Material	**Thickness**
MDOT 3500 Portland Cement Concrete	6 inches
MDOT 21AA Limestone Dense-Graded Aggregate	8 inches

Large front-loading refuse trucks can impose significant concentrated wheel loads within trash dumpster pick-up areas. Therefore, we recommend 8 inches of Portland cement concrete pavement be used in this area and be large enough to accommodate the entire truck during pick-up operations.

All pavement materials are specified within the 2020 Standard Specifications for Construction from the Michigan Department of Transportation. The bituminous pavement materials are described in Sections 501 and 904 and can be assigned a structural coefficient number of 0.42. The aggregate materials for the subbase are described in Section 902 and can be assigned a structural coefficient number of 0.14. We recommend that bituminous concrete utilize grade PG 64-28 binder, with no more than 17 percent of the overall binder content from reclaimed asphalt pavement (RAP) within the top wearing course layer. The Portland cement concrete materials are described in Section 1004. It is recommended that 3500 grade concrete mixtures contain at least 25 percent GGBFS substitution for Portland cement or use low alkali (0.6% or less total cement alkali) Type I or Type II cement.

Proper pavement drainage is essential given the cohesive soil conditions. We recommend edge drains be provided continuously along curbs since they can become a source of water infiltration into the pavement subgrade. Such drains

should extend to minimum depths of 4 inches below the bottom of the proposed aggregate base course or granular fill placed within undercut areas. These drains could be connected to nearby catch basins. The pavement and subgrade should be properly sloped to promote effective surface and subsurface drainage and prevent water from ponding. We also recommend pavement subbase materials consist of non-frost-susceptible aggregates where possible.

We recommend that the joints within newly constructed Portland cement concrete pavements be sealed with hot rubber to prevent moisture intrusion into the subgrade soils below, as well as prevent spalling of the joint due to material entering the joint.

In addition, regular joint maintenance should be performed. Regular timely maintenance should be performed on the pavement to reduce the potential deterioration associated with moisture infiltration through surface cracks. The owner should be prepared to seal the cracks with a hot-applied elastic crack filler as soon as possible after cracking develops and as often as necessary to block the passage of water to the subgrade soils.

NEW BUILDING CONSTRUCTION CONSIDERATIONS

We expect foundation excavations will extend to a minimum of 3-1/2 feet below existing grades and utility excavations will extend to depths from 5 to 7 feet. Groundwater was encountered between 19-1/2 and 26 feet during drilling operations within B-03, B-04, B-08, B-09, and B-11. Therefore, we anticipate construction excavations for the proposed building and underground utilities will be performed in the dry. However, any surface groundwater, surface run-off or accumulations within construction excavations should be controllable by pumping from property constructed sumps.

We anticipate footing excavations can be earth formed based on the predominantly silty clay subgrade soils. However, if granular soils are used to raise the site, caving soils may be encountered. The sides of spread and/or strip footings should be constructed straight and vertical to reduce the risk of frozen soil adhering to the concrete and raising the foundations. In granular soils, the contractor should be prepared to over excavate and form footings. All excavations should be backfilled with engineered fill when supporting overlying structures such as floor slabs.

Where excavations extend below a depth of 5 feet and are to be entered by a human, we recommend a maximum slope of two horizontal unit to one vertical unit (2H:1V) within granular fill soils, 1H:1V within the stiff cohesive soils, and 3/4H:1V within the very stiff to hard cohesive soils in dry conditions. Where seepage from excavation cuts is observed, the slopes must be flattened sufficiently to achieve stability, but in no case left steeper that 3H:1V at and below the seepage level.

All excavations should be safely sheeted, shored, sloped, or braced in accordance with MI-OSHA requirements. If material is stored or equipment is operated near an excavation, stronger shoring must be used to resist the extra pressure due to the superimposed loads.

TRAFFIC SIGNAL FOUNDATION RECOMMENDATIONS

Based on MDOT standards and the project details, the foundation for the traffic signal poles should consist of a 42-inch diameter drilled pier foundation for single mast arm poles. The foundation depth depends on the supporting soils N-values or undrained shear strength and span lengths between poles, as described within the MDOT "Traffic Signal Mast Arm Pole Foundation Design Table – SIG-DESIGN-284-A", dated May 17, 2024. The single mast arm length for the traffic signal to be constructed at the B-02 location is 45 feet and the single mast arm length at the remaining three (3) locations is 55 feet.

We recommend the proposed traffic signal poles be supported by foundations in accordance with the following table per MDOT standards:

Soil Boring	Single Mast Arm Pole	
	Soil Type	Foundation Depth (feet)
B-01	High Clay	12.5
B-02	High Clay	11.5
B-03	High Clay	12.5
B-04	High Clay	12.5

Note: Due to the presence of collapsible soils, temporary casing will be required within drilled pier excavation at boring B-01.

The above recommendations are based on the MDOT Traffic Signal Mast Arm Pole Foundation Design Table S1G-DESIGN-284-A, using the encountered soil condition and single arm mast poles.

Soil parameters that may be used for foundation design are presented below.

Soil Boring B-01 (West Quadrant)

Depth (feet)	Total Unit Weight (pcf)	Cohesion (psf)	Angle of Friction (Degrees)	Soil Modulus (pci)
0 to 2-1/2	110	0	30	2
2-1/2 to 6	125	3,250	0	300
6 to 18	130	4,500	0	450
18 to 23	125	3,375	0	300
23 to 25	130	4,500	0	450

Soil Boring B-02 (North Quadrant)

Depth (feet)	Total Unit Weight (pcf)	Cohesion (psf)	Angle of Friction (Degrees)	Soil Modulus (pci)
0 to 3-1/2	125	2,750	0	250
3-1/2 to 11	130	4,500	0	450
11 to 18	125	3,250	0	300
18 to 25	130	4,500	0	450

Soil Boring B-03 (East Quadrant)

Depth (feet)	Total Unit Weight (pcf)	Cohesion (psf)	Angle of Friction (Degrees)	Soil Modulus (pci)
0 to 6	125	2,500	0	250
6 to 16	130	4,500	0	450
16 to 20	125	2,750	0	250
20 to 25	130	0	37	125

Soil Boring B-04 (South Quadrant)

Depth (feet)	Total Unit Weight (pcf)	Cohesion (psf)	Angle of Friction (Degrees)	Soil Modulus (pci)
0 to 3-1/2	120	2,000	0	200
3-1/2 to 13	125	4,000	0	400
13 to 21	125	3,000	0	300
21 to 25	130	0	37	125

DRILLED PIER CONSTRUCTION CONSIDERATIONS

Caving and sloughing of the granular fill soils within the upper 2-1/2 feet within boring B-01 will occur during drilled pier foundation excavations. Therefore, the contractor should come to the site prepared to use temporary steel casing, as necessary to maintain a stable excavation during construction operations.

Once drilling is completed to the design depth, reinforcing steel should be set and concrete placed. Concrete must be placed until a positive head of concrete has been established within the casing. This positive concrete head must be maintained while pulling the casing to prevent the infiltration of loose soil into the fresh concrete. After concrete has been placed to an appropriate grade, the casing may be removed and concrete placement operations completed.

To reduce lateral movement of the drilled pier foundations, the contractor must place the concrete for the piers in intimate contact with undisturbed soil. Fill any voids or enlargements in the drilled pier shaft excavations with concrete at the time of drilled pier concrete placement. We recommend using a concrete mix design with a slump of 4 to 6 inches for freefall placement to reduce the potential for concrete arching and provide a workable material. We recommend using a temporary form, such as sono tube, to form the top portion of the drilled piers. The use of this top form is a very beneficial aid to the correct placement of the anchor bolts.

Underground utilities are present in close proximity to the proposed traffic signal foundations. The contractor should be prepared to expose and protect the existing utilities from damage during construction operations.

RETAINING WALL RECOMMENDATIONS

No information regarding retaining wall type, heights, or locations was available upon completion of this report.
Site subsurface conditions are suitable for conventional gravity block retaining wall structures consisting of conventional concrete retaining walls and reinforced earth retaining walls with modular block façade walls. We recommend retaining walls bear on the native very stiff to hard silty clay or engineered fill placed over native soils. We recommend retaining walls be designed based on an allowable bearing capacity of 3,000 psf. Retained soils should be modeled based on a unit weight of 125 pcf and a long term internal angle of friction of 28 degrees.

In order to maintain drained conditions behind the retaining wall, we recommend free-draining granular soils with less than 8 percent fines (minus No. 200 sieve size) be used as backfill behind retaining walls. The backfill should be compacted to 95 percent of the maximum dry density as determined by modified Proctor compaction test D 1157. The compacted backfill can be assigned an internal friction angle of 32 degrees and a unit weight of 120 pcf for design purposes. Additionally, an open graded, clean, granular drainage layer and perforated drain pipe should be installed behind the retaining walls. The drain pipe should outlet at low points or at the end of wall. The open-graded stone should be encapsulated in filter fabric to prevent the infiltration of fine soil particles into the stone. Open-graded, crushed stone can be assigned an internal friction angle of 35 degrees and a unit weight of 125 pcf.

Lateral earth pressures are significantly influenced by the type and intensity of backfill compaction. We recommend thin lifts (approximately 6 inches per lift) of backfill be placed and relatively small compaction equipment be used to compact retaining wall backfill. Additionally, a qualified geotechnical engineer or technician should be on site to observe construction of the walls and to perform appropriate testing.

GENERAL COMMENTS

We have formulated the evaluations and recommendations presented in this report relative to site preparation and foundations on the basis of data provided to us relating to the project location, type of structure, and surface grade for the proposed site. Any significant change in this data should be brought to our attention for review and evaluation with respect to prevailing subsurface conditions. Furthermore, if changes occur in the design, location, or concept of the

project, conclusions and recommendations contained in this report are not valid unless G2 Consulting Group, LLC reviews the changes. G2 Consulting Group, LLC will then confirm the recommendations presented herein or make changes in writing.

The scope of the present investigation was limited to evaluation of subsurface conditions for the support of proposed building, pavements, mast-arm traffic signals, and other related aspects of the development. No chemical, environmental, or hydrogeological testing or analyses were included in the scope of this investigation.

We base the analyses and recommendations submitted in this report upon the data from the soil borings performed at the approximate locations shown on the Soil Boring Location Plan, Plate No. 1. This report does not reflect variations that may occur between the actual boring locations and the actual structure location. The nature and extent of any such variations may not become clear until the time of construction. If significant variations then become evident, it may be necessary for us to re-evaluate our report recommendations.

We recommend G2 Consulting Group, LLC observe all geotechnical related work, including foundation construction, subgrade preparation, and engineered fill placement. G2 Consulting Group, LLC will perform the appropriate testing to confirm the geotechnical conditions given in the report are found during construction.

APPENDIX

SOIL BORING LOCATION PLAN	PLATE NO. 1
SOIL BORING LOGS	FIGURE NO. 1 THROUGH 11
UNCONFINED COMPRESSIVE STRENGTH TEST	FIGURE NO. 12
ATTERBERG LIMITS RESULTS	FIGURE NO. 13
GENERAL NOTES TERMINOLOGY	FIGURE NO. 14

APPENDIX A

SOIL BORING LOCATION PLAN	PLATE NO. 1
SOIL BORING LOGS	FIGURE NO. 1 AND 2
UNCONFINED COMPRESSIVE STRENGTH TEST	FIGURE NO. 3
GENERAL NOTES TERMINOLOGY	FIGURE NO. 4
PRODUCT MANUAL	FIGURE NO. 5
CONSTRUCTION SEQUENCE	FIGURE NO. 6

APPENDIX B

DOCUMENT NAME	#
DOCUMENT NAME	#
DOCUMENT NAME	#

APPENDIX C

DOCUMENT NAME	#
DOCUMENT NAME	#
DOCUMENT NAME	#

Legend

Soil Borings performed by Strata Drilling, Inc. on March 10, 13, and 14, 2025

Soil Boring Location Plan		
Proposed Lake House Facility Belleville Road at Quirk Road Van Buren Township, Michigan		
2G CONSULTING GROUP	Project No. 250079	
	Drawn by: JMH	
	Date: 4/24/25	Plate No. 1
	Scale: NTS	

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213433° Longitude: -83.491971°

Soil Boring No. **B-01**

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 668.9 ft

Topsoil: Dark Brown Silty Sand (10 inches) — 0.8

Fill: Medium Compact Brown Gravelly Sand with trace silt — 2.5

Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel — 21.0

Very Stiff to Hard Gray Silty Clay with trace sand and gravel, occasional sand seams — 25.0

End of Boring @ 25 ft

SOIL SAMPLE DATA

ELEV. (ft)	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		S-1	6 9 6	15			
663.9	5	S-2	4 8 13	21	16.4		6500*
		S-3	7 12 19	31	17.2		9000*
658.9	10	S-4	8 11 20	31	16.9		9000*
		S-5	6 12 18	30	16.1		9000*
653.9	15	S-6	6 13 20	33	14.7		9000*
		S-7	7 12 17	29	19.3		9000*
648.9	20	S-8	7 10 14	24	22.6		7500*
		S-9	6 9 11	20	10.2		6000*
643.9	25	S-10	9 18 16	34	11.9		9000*
638.9	30						
633.9	35						

Total Depth: 25 ft
Drilling Date: March 10, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
Dry during and upon completion

Notes:
Traffic Signal at West Corner of Belleville and Quirk
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 1

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213598° Longitude: -83.491758°

Soil Boring No. **B-02**

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 670.1 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Silty Clay (11 inches) 0.9	
665.1		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel	5
660.1			10
		11.0	
655.1		Very Stiff to Hard Gray Silty Clay with trace sand and gravel, occasional sand seams	15
650.1			20
645.1		25.0	25
		End of Boring @ 25 ft	
640.1			30
635.1			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-1	5 6 12	18	15.5		5500*
S-2	7 11 14	25	16.3		8000*
S-3	7 12 20	32	17.1		9000*
S-4	9 13 21	34	15.2		9000*
S-5	5 10 14	24	16.3		7500*
S-6	5 8 13	21	15.5		6500*
S-7	5 8 12	20	16.4		6000*
S-8	6 9 14	23	17.3		8000*
S-9	6 10 21	31	16.0		9000*
S-10	6 13 30	43	12.0		9000*

Total Depth: 25 ft
Drilling Date: March 10, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
Dry during and upon completion

Notes:
Traffic Signal at North Corner of Belleville and Quirk
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 2

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213398° Longitude: -83.491509°

Soil Boring No. **B-03**

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 668.4 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Silty Clay (6 inches) 0.5	
663.4		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel	5
658.4			10
653.4			15
648.4		16.0 Very Stiff to Hard Gray Silty Clay with trace sand and gravel, occasional sand seams 20.0	20
643.4		Compact Gray Silty Sand with trace gravel, occasional clay seams 25.0	25
638.4		End of Boring @ 25 ft	30
633.4			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-1	3 4 8	12	17.5		4000*
S-2	4 7 12	19	15.8		6000*
S-3	7 11 19	30	15.9		9000*
S-4	8 12 19	31	16.3		9000*
S-5	6 11 19	30	16.5		9000*
S-6	8 15 21	36	18.1		9000*
S-7	7 10 12	22	18.0		6500*
S-8	4 5 15	20	16.8		5000*
S-9	11 22 19	41			
S-10	19 21 20	41			

Total Depth: 25 ft
Drilling Date: March 14, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
19-1/2 feet during drilling; 21 feet upon completion

Notes:
Traffic Signal at East Corner of Belleville and Quirk
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 3

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213234° Longitude: -83.491756°

Soil Boring No. **B-04**

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 666.3 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Silty Clay (4 inches) 0.3	
661.3		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel	5
656.3			10
651.3			15
646.3		18.0 Very Stiff Gray Silty Clay with trace sand and gravel, occasional sand seams	20
641.3		21.0 Compact Gray Silty Sand with trace gravel, occasional clay seams 25.0	25
636.3		End of Boring @ 25 ft	30
631.3			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-1	3 3 7	10	16.0		4000*
S-2	6 10 15	25	15.3		8000*
S-3	10 13 22	35	16.0		9000*
S-4	6 11 17	28	16.0		8500*
S-5	6 11 19	30	16.7		9000*
S-6	6 10 13	23	15.8		7000*
S-7	7 9 13	22	19.5		7000*
S-8	5 6 10	16	23.1		5000*
S-9	9 16 20	36			
S-10	14 17 18	35			

Total Depth: 25 ft
Drilling Date: March 14, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
21 feet during drilling; 22 feet upon completion

Notes:
Traffic Signal at South Corner of Belleville and Quirk
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 4

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213312° Longitude: -83.491255°

Soil Boring No. **B-05**

CONSULTING GROUP

SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 666.3 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (3 inches) 0.3							
				S-1	4 8 12	20	14.7		6000*
661.3		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel	5	S-2	6 13 18	31	13.9		9000*
				S-3	7 12 18	30	15.5		9000*
656.3		10.0	10	S-4	7 14 20	34	18.1		9000*
		End of Boring @ 10 ft							
651.3			15						
646.3			20						
641.3			25						
636.3			30						
631.3			35						

Total Depth: 10 ft
Drilling Date: March 13, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
Dry during and upon completion

Notes:
Proposed Pavements
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 5

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213515° Longitude: -83.490869°

Soil Boring No. **B-06**

G2 CONSULTING GROUP

SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 669.8 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (12 inches) 1.0							
				S-1	0 3 4	7	14.3		4000*
664.8			5	S-2	5 9 12	21	14.4		6000*
		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel		S-3	6 13 18	31	14.2		9000*
659.8		10.0	10	S-4	8 16 27	43	14.2		9000*
		End of Boring @ 10 ft							
654.8			15						
649.8			20						
644.8			25						
639.8			30						
634.8			35						

Total Depth: 10 ft
Drilling Date: March 13, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
Dry during and upon completion

Notes:
Proposed Pavements
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 6

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213628° Longitude: -83.490330°

Soil Boring No. **B-07**

CONSULTING GROUP

SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 675.1 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (6 inches) 0.5							
				S-1	5 7 12	19	14.2		6000*
670.1		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel	5	S-2	7 14 21	35	17.6		9000*
				S-3	7 14 18	32	14.9		9000*
665.1		10.0	10	S-4	6 12 17	29	14.6		9000*
		End of Boring @ 10 ft							
660.1			15						
655.1			20						
650.1			25						
645.1			30						
640.1			35						

Total Depth: 10 ft
Drilling Date: March 13, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
Dry during and upon completion

Notes:
Proposed Pavements
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 7

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213184° Longitude: -83.490836°

Soil Boring No. **B-08**

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 664.0 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Silty Clay (6 inches) 0.5	
659.0		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel	5
654.0			10
649.0		14.5	15
644.0		Very Stiff to Hard Gray Silty Clay with trace sand and gravel, occasional sand seams	20
639.0		26.0	25
634.0		Very Compact Gray Silty Sand with trace gravel, occasional clay seams 30.0	30
629.0		End of Boring @ 30 ft	35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-1	4 7 13	20	15.3		6000*
S-2	5 10 15	25	15.8		8000*
S-3	7 12 17	29	15.8		9000*
S-4	8 13 17	30	17.2		9000*
S-5	6 10 13	23	18.2		7000*
S-6	5 8 18	26	19.6		8500*
S-7	8 14 16	30	9.2		9000*
S-8	5 22 31	53			

Total Depth: 30 ft
Drilling Date: March 13, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
26 feet during drilling; 24 feet upon completion

Notes:
Proposed Building
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 8

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213131° Longitude: -83.490689°

Soil Boring No. **B-09**

G2 CONSULTING GROUP

SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 662.9 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (6 inches) 0.5							
				S-1	3 5 9	14	16.3		4500*
657.9			5	S-2	6 10 15	25	15.4		8000*
		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel		S-3	5 9 15	24	16.9		7500*
652.9			10	S-4	5 9 13	22	18.6		7000*
		13.0							
647.9			15	S-5	4 6 9	15	18.3		4500*
		Very Stiff Gray Silty Clay with trace sand and gravel, occasional sand seams							
642.9			20	S-6	3 4 7	11	12.4		4000*
		23.0							
637.9			25	S-7	8 19 20	39			
		Compact Gray Silty Sand with trace gravel, occasional clay seams							
632.9		30.0	30	S-8	9 21 27	48			
		End of Boring @ 30 ft							
627.9			35						

Total Depth: 30 ft
Drilling Date: March 13, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
25 feet during drilling; 27 feet upon completion

Notes:
Proposed Building
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 9

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213248° Longitude: -83.490652°

Soil Boring No. **B-10**

G2 CONSULTING GROUP

SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 665.5 ft

ELEV. (ft)	PRO-FILE		DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (6 inches) 0.5							
				S-1	3 5 9	14	11.3		4500*
660.5			5	S-2	7 11 22	33	14.8		9000*
				S-3	6 11 18	29	15.6		8500*
655.5		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel	10	S-4	5 10 15	25	15.9		7500*
650.5			15	S-5	5 11 14	25	18.9		7500*
		17.0							
645.5		Very Stiff Gray Silty Clay with trace sand and gravel, occasional sand seams	20	S-6	3 5 7	12	18.0		4000*
		23.5							
640.5		Compact Gray Silty Sand with trace gravel, occasional clay seams	25	S-7	13 16 20	36			
		26.0							
635.5		Very Stiff Gray Silty Clay with trace sand and gravel, occasional sand seams 30.0	30	S-8	7 9 15	24			6000*
630.5		End of Boring @ 30 ft	35						

Total Depth: 30 ft
Drilling Date: March 14, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

Water Level Observation:
Dry during and upon completion

Notes:
Proposed Building
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 10

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No. 250079

Latitude: 42.213344° Longitude: -83.490417°

Soil Boring No. **B-11**

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 665.5 ft

ELEV. (ft)	PRO-FILE	Description	Depth (ft)
		Topsoil: Dark Brown Silty Clay (12 inches)	1.0
		Fill: Stiff Dark Brown Silty Clay with trace sand, gravel, and organic matter (Organic Matter Content = 6.9%)	3.0
660.5		Stiff to Very Stiff Brown and Gray Silty Clay with trace sand and gravel	5
			8.0
655.5			10
650.5		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel	15
			17.0
645.5		Very Stiff Gray Silty Clay with trace sand and gravel, occasional sand seams	20
			23.0
640.5		Compact Gray Silty Sand with trace gravel, occasional clay seams	25
635.5			30.0 30
630.5		End of Boring @ 30 ft	35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-1	1 3 5	8	36.6		2500*
S-2	3 3 5	8	19.7	103	2730
S-3	5 8 11	19	16.0		6000*
S-4	5 8 17	25	13.8		8000*
S-5	6 10 15	25	17.2		8000*
S-6	4 7 9	16	18.7		5000*
S-7	11 18 18	36			
S-8	11 15 22	37			

Total Depth: 30 ft
Drilling Date: March 13, 2025
Inspector:
Contractor: Strata Drilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
2-1/4 inch inside diameter hollow-stem augers

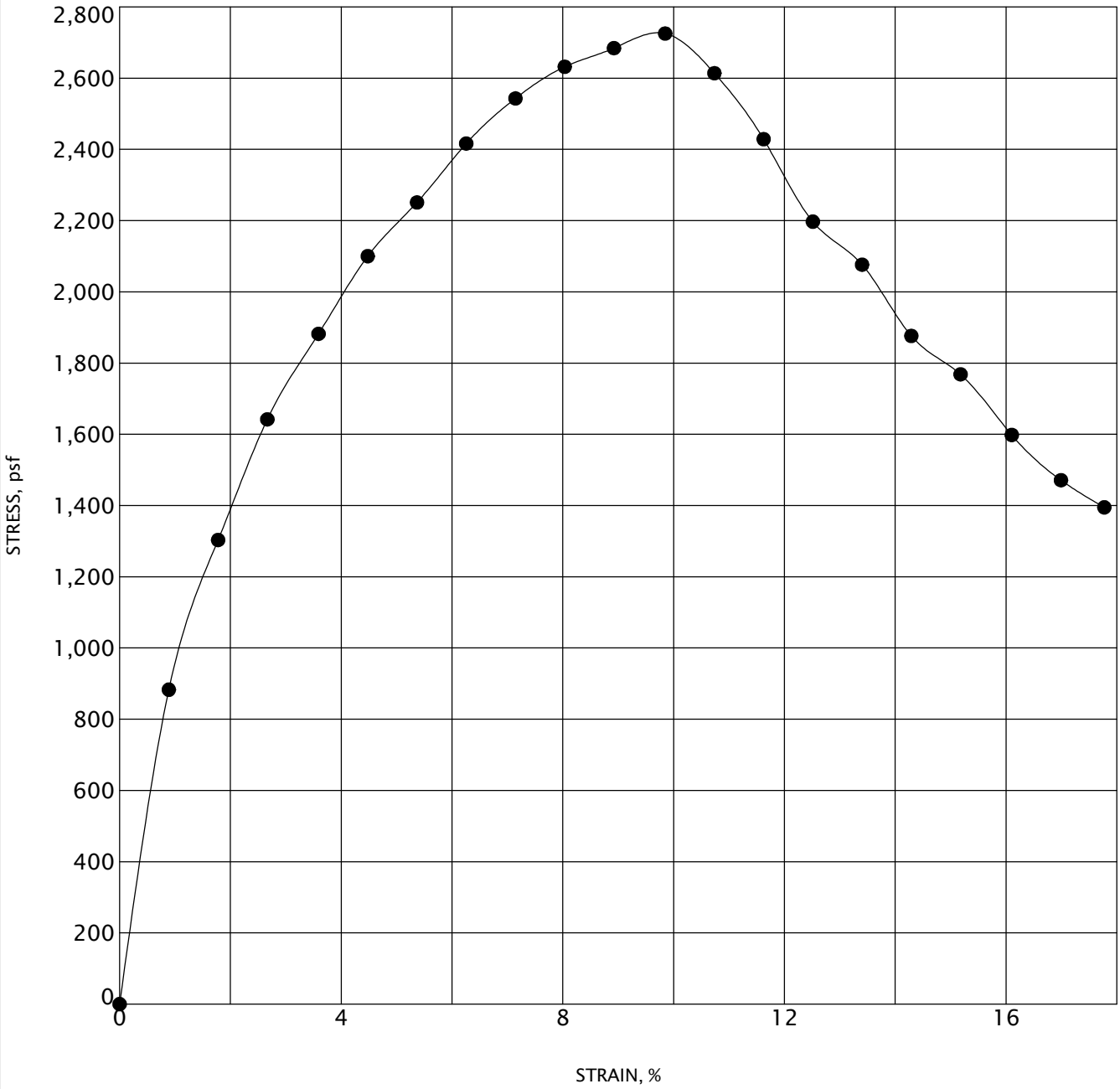
Water Level Observation:
25 feet during drilling; 27 feet upon completion

Notes:
Proposed Building
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 11

SOIL / PAVEMENT BORING 250079.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 5/8/25



	Specimen		Classification	MC%	γ_d	UC
●	B-11	S-2	Brown and Gray Silty Clay	20	103	2730

G2 CONSULTING GROUP

UNCONFINED COMPRESSIVE STRENGTH TEST

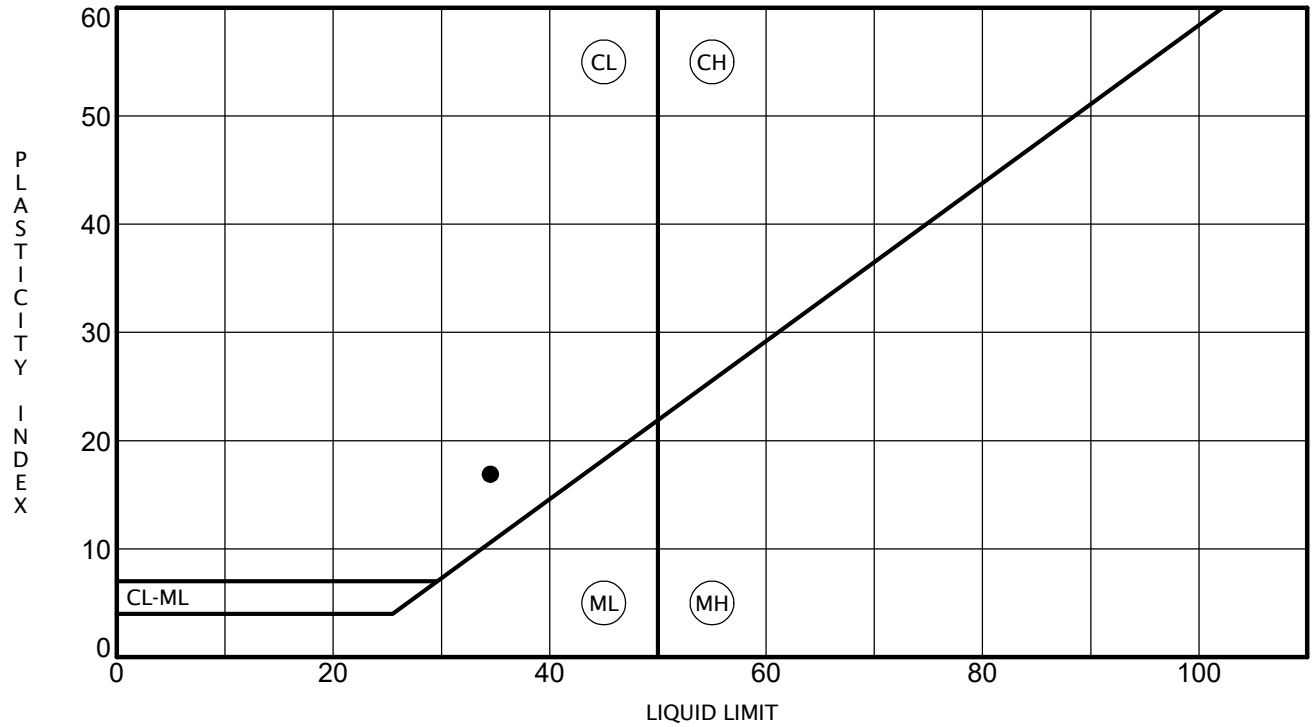
Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No.: 250079

Figure No. 12

US_UNCONFINED 250079.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 4/8/25



	Specimen Identification		LL	PL	PI	Fines	M %	Classification
●	B-05	S-1	35	18	17		15	Brown and Gray Silty Clay

ATTERBERG LIMITS RESULTS

CONSULTING GROUP

Project Name: Proposed Lake House Facility

Project Location: Belleville Road at Quirk Road
Van Buren Township, Michigan

G2 Project No.: 250079

Figure No. 13

US_ATTERBERG_LIMITS 250079.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 4/8/25

GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM D 653.

PARTICLE SIZE

Boulders		- greater than 12 inches
Cobbles		- 3 inches to 12 inches
Gravel	- Coarse	- 3/4 inches to 3 inches
	- Fine	- No. 4 to 3/4 inches
Sand	- Coarse	- No. 10 to No. 4
	- Medium	- No. 40 to No. 10
	- Fine	- No. 200 to No. 40
Silt		- 0.005mm to 0.074mm
Clay		- Less than 0.005mm

CLASSIFICATION

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent (percent by weight)	**Minor Constituent (percent by weight)**
Trace - 1 to 12%	Trace - 1 to 12%
Adjective - 12 to 35%	Little - 12 to 23%
And - over 35%	Some - 23 to 33%

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier, i.e. sandy clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils, i.e. silty clay, trace sand, little gravel.

Consistency	**Unconfined Compressive Strength (psf)**	**Approximate Range of (N)**
Very Soft	Below 500	0 - 2
Soft	500 - 1,000	3 - 4
Medium	1,000 - 2,000	5 - 8
Stiff	2,000 - 4,000	9 - 15
Very Stiff	4,000 - 8,000	16 - 30
Hard	8,000 - 16,000	31 - 50
Very Hard	Over 16,000	Over 50

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

COHESIONLESS SOILS

Density Classification	**Relative Density %**	**Approximate Range of (N)**
Very Loose	0 - 15	0 - 4
Loose	16 - 35	5 - 10
Medium Compact	36 - 65	11 - 30
Compact	66 - 85	31 - 50
Very Compact	86 - 100	Over 50

Relative Density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

SAMPLE DESIGNATIONS

AS - Auger Sample – Cuttings directly from auger flight
BS - Bottle or Bag Samples
S - Split Spoon Sample - ASTM D 1586
LS - Liner Sample with liner insert 3 inches in length
ST - Shelby Tube sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0 inch outside-diameter, 1-3/8 inch inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

REPORT ON GEOTECHNICAL INVESTIGATION

LAKESIDE PARK (PROPOSED LAKE HOUSE FACILITY)

BELLEVILLE ROAD AT QUIRK ROAD
VAN BUREN TOWNSHIP, MICHIGAN 48111

LATITUDE 42.21306 N
LONGITUDE 83.49108˚ W

CONSULTING GROUP

Prepared for:

Fishbeck
31440 Northwestern Highway, Suite #250
Farmington Hills, Michigan 48334

G2 Project No. 250079s
July 24, 2026

July 24, 2026

Mr. Daniel Rhoton, P.E.
Senior Civil Engineer
Fishbeck
31440 Northwestern Highway, Suite #250
Farmington Hills, Michigan 48334

RE: Report on Geotechnical Investigation
Lakeside Park (Proposed Lake House Facility)
Belleville Road at Quirk Road
Van Buren Township, Michigan 48111
G2 Project No. 250079s

Dear Mr. Rhoton:

We have completed the supplemental geotechnical and infiltration investigation for the proposed Lakeside Park to be constructed on the southeast side of the intersection of Belleville Road and Quirk Road within the Township of Van Buren, Michigan. This report presents the results of our observations and analysis, together with our recommendations for foundation construction, retaining wall design, boardwalk and dock foundations, infiltration suitability, subgrade preparation, and construction considerations. This investigation supplements our original geotechnical investigation for this site (G2 Project No. 250079, dated May 7, 2025).

We appreciate the opportunity to be of service to Fishbeck and look forward to discussing the recommendations presented. In the meantime, if you have any questions regarding the report or any other matter pertaining to the project, please call us.

Sincerely,

G2 Consulting Group, LLC

Ryan P. Carpus, P.E.
Project Engineer

Jeffrey M. Hayball, P.E.
Project Manager

RPC/JMH/LJB/ljv

Enclosures

EXECUTIVE SUMMARY

The project includes construction of the proposed Lakeside Park on the southeast side of the intersection of Belleville Road and Quirk Road in Van Buren Township, Michigan. The project includes two single-story, slab-on-grade buildings — a Community Lakehouse with an approximate footprint of 4,000 square feet and a finished floor elevation of FFE 665.0 feet, and a Lake Hall with an approximate footprint of 6,000 square feet and a finished floor elevation of FFE 668.5 feet — located within opposite corners of the property. A new block retaining wall with a maximum height of approximately 10 feet is proposed on the east side of the site. A new boardwalk is proposed along Belleville Lake, which is present on the south edge of the park, and new boat docks and a fishing pier are proposed extending east of the Belleville Road embankment and south of the park site. Underground stormwater detention systems with an invert elevation of approximately 8 feet below existing grades will be constructed in conjunction with the project.

Approximately 2 to 12 inches of topsoil are present at the ground surface of the borings. Sandy gravel fill with concrete debris underlies the topsoil within boring B-09 and extends to a depth of 14 feet. Native stiff to hard silty clay underlies the topsoil within the remaining borings and the fill within boring B-09, extending to the explored depths ranging from 10 to 49-1/2 feet; native very compact silt and hard to very stiff clayey silt are present at depth within borings B-05, B-06, and B-08. Groundwater was encountered within borings B-01, B-05, B-08, and B-09 at depths ranging from 18-1/2 to 29 feet during drilling operations, and was measured at depths ranging from 17-1/2 to 46-1/2 feet upon completion; no measurable groundwater was encountered within the remaining borings.

We recommend the proposed Community Lakehouse and Lake Hall buildings be supported on conventional strip and spread footing foundations bearing on native very stiff to hard silty clay or engineered fill placed over native soils. Foundations bearing on the aforementioned soils may be designed using a net allowable soil bearing pressure of 3,000 pounds per square foot (psf).

We recommend the proposed boardwalk be supported on helical piers bearing within the native stiff to hard silty clay soils that exist along the shoreline and extend from below the surface materials to approximately elevation 641 feet. We recommend the boardwalk employ a triple helix configuration with an 8-inch, 10 inch, and 12 inch diameter plates on a lead section that is 10-1/2 feet in length. The helical piers should extend such that all helix bear within the stiff to hard silty clay soils encountered at borings B-7 and B-8. Each lead section should be extended such that the top helical plate is at least 48 inches below final site grades. We recommend using an allowable axial capacity of 10 kips per pile for the noted triple helix configuration. Smaller helix configurations will result in lower maximum capacities.

Loading conditions for the proposed fishing pier foundations were not available at the time of this report. However, we understand the fishing pier may be designed using driven steel piles. Steel pipe piles, driven open ended, are typically used to support docks and for boat mooring. Steel pipe pile diameters (O.D.) of 10-3/4 inches (wall thickness of 0.188 inches) or (O.D.) 12-3/4 inches (wall thickness of 0.250 inches) are common for dock and mooring piles. It is recommended that open ended pipe piles be designed with estimated tip elevations of 630 feet. This will allow for approximately 5 feet of penetration into the hard silty clay soils encountered within boring B-9 below a depth of 22 feet. Steel pipe piles, nominally 10 inches in diameter, are expected to develop allowable vertical load capacities of 15 Kips per pile when installed to a tip elevation of 630 feet, and nominally 12 inch diameter pipe piles are expected to develop an allowable vertical capacity of 20 Kips per pile installed to this same tip elevation.

Do not consider this summary separate from the entire text of this report, with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are discussed in the following sections and in the Appendix of this report.

PROJECT DESCRIPTION

The project includes construction of the proposed Lakeside Park on the southeast side of the intersection of Belleville Road and Quirk Road in Van Buren Township, Michigan. The project includes two single-story, slab-on-grade buildings — a Community Lakehouse with an approximate footprint of 4,000 square feet and a finished floor elevation of FFE 665.0 feet, and a Lake Hall with an approximate footprint of 6,000 square feet and a finished floor elevation of FFE 668.5 feet — located within opposite corners of the property. A new block retaining wall with a maximum height of approximately 10 feet is proposed on the east side of the site. A new boardwalk is proposed along Belleville Lake, which is present on the south edge of the park, and new boat docks and a fishing pier are proposed extending east of the Belleville Road embankment and south of the park site. Underground stormwater detention systems with an invert elevation of approximately 8 feet below existing grades will be constructed in conjunction with the project. Based on the provided information regarding final site grades, grade increases on the order of 3 to 4 feet are anticipated on the south sides of each building. We assume the proposed buildings will be subject to wall loads ranging from 1 to 2 kips per lineal foot and individual column loads ranging from 50 to 100 kips. We understand the proposed boat docks and fishing pier will be supported on deep foundation elements with an estimated load of 8 kips per pile, plus or minus 5 kips.

The purpose of our exploration is to determine and evaluate the general subsurface conditions at the site and to develop related recommendations for the support of the proposed buildings, retaining wall, boardwalk, and dock/fishing pier foundations, infiltration suitability, floor slab design, site preparation, and construction considerations as they relate to the project.

This investigation supplements our original geotechnical investigation for this site (G2 Project No. 250079, dated May 7, 2025), which was performed for a single-building layout with associated pavements, retaining walls, utilities, and mast-arm traffic signals. If the loading conditions, proposed grades, structure locations, or other assumptions vary from those presented herein, G2 Consulting Group, LLC (G2) should be notified so that we can review the recommendations provided within this report.

SCOPE OF SERVICES

The field operations, laboratory testing, and engineering report preparation were performed under direction and supervision of a licensed professional engineer in the State of Michigan. Our services were performed according to generally accepted standards and procedures in the practice of geotechnical engineering in this area. Our scope of services for this project is as follows:

1. We drilled a total of nine (9) supplemental soil borings, designated B-01 through B-09, extending to depths ranging from 10 to 49-1/2 feet below existing grade. Soil borings B-01 and B-02 were drilled within the footprints of the proposed buildings, extending to a depth of 20 feet each. Soil borings B-03 and B-04 were performed within the proposed underground detention/infiltration areas, extending to a depth of 10 feet each. Soil borings B-05 and B-06 were drilled within the proposed retaining wall alignment, extending to a depth of 30 feet each. Soil borings B-07 and B-08 were performed along the proposed boardwalk alignment, extending to a depth of 20 feet each. Soil boring B-09 was drilled near the proposed boat docks and fishing pier, extending to a depth of 49-1/2 feet.

2. We performed muck probing along the proposed boardwalk alignment along the edge of Belleville Lake to determine the amount of soft/unsuitable soil present.

3. We performed laboratory testing on representative soil samples obtained from the soil borings. Laboratory testing included visual engineering classification, natural moisture content, organic matter content, unconfined compressive strength, and Atterberg Limits determinations, as applicable.

4. We prepared this engineering report. The report includes recommendations regarding foundation types suitable for the soil conditions encountered, allowable bearing capacities of the anticipated bearing soil layers, estimated settlement, retaining wall soil design parameters, boardwalk and dock/fishing pier foundation recommendations, infiltration suitability, and construction considerations related to site preparation and foundation construction.

FIELD OPERATIONS

Fishbeck, in conjunction with G2 Consulting Group, LLC, selected the number, depth, and location of the soil borings. We field located the soil borings using a GPS-assisted mobile device and by measuring from known surface features using conventional taping methods. The ground surface elevations at the soil boring locations, ranging from approximately 657.0 to 672.5 feet, were estimated by overlaying the provided topographic survey atop our soil boring location plan and interpolating between contours. We depict the approximate soil boring locations on the Soil Boring Location Plan, Plate No. 1 in the Appendix. The proposed site is currently heavily wooded, and brush clearing and limited tree removal along 10-foot-wide access paths were necessary to provide track-mounted ATV drill rig access.

The soil borings were drilled by Strata Drilling, Inc. using a track-mounted all-terrain vehicle (ATV) drill rig. The driller used 4-1/4-inch diameter hollow-stem augers to advance the soil borings to the explored depths. The driller obtained soil samples at intervals of 2-1/2 feet within the upper 10 feet and at 5-foot intervals thereafter. The soil samples were obtained using the Standard Penetration Test (SPT) method (ASTM D1586), which involves driving a 2-inch diameter split-spoon sampler into the soil with a 140-pound weight falling 30 inches. The sampler is driven in three successive 6-inch increments, with the number of blows for each increment recorded. The number of blows required to advance the sampler the last 12 inches is termed the Standard Penetration Resistance (N). The blow counts for each 6-inch increment and the resulting N-value are presented on the soil boring logs.

The soil samples were placed in sealed containers in the field, and a G2 representative brought them to our laboratory for testing and classification. During field operations, the driller maintained logs of the encountered subsurface conditions, including changes in stratigraphy and observed groundwater levels. The final boring logs are based on the field logs supplemented by laboratory classification and test results. After completion of drilling operations, the boreholes were backfilled with on-site soils.

LABORATORY TESTING

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to foundation design and construction. An experienced geotechnical engineer classified the soil samples in general conformance with the G2 General Notes Terminology and the Visual-Manual Procedure of the Unified Soil Classification System (ASTM D2488). Laboratory testing included moisture content determinations in accordance with ASTM D2216: Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. The unconfined compressive strengths were determined by using a spring-loaded hand penetrometer. The hand penetrometer estimates the unconfined compressive strength to a maximum of 4-1/2 tons per square foot (tsf) by measuring the resistance of the soil sample to the penetration of a calibrated spring-loaded cylinder.

We present the results of the moisture content and unconfined compressive strength determinations on the logs at the depths we obtained the soil samples. We will hold the soil samples for a period of 60 days following the issuance of this report, after which we will discard them. If you would like to have the soil samples, please coordinate their pickup prior to the discard date.

SITE DESCRIPTION

The proposed site is located on the southeast side of the intersection of Belleville Road and Quirk Road within Van Buren Township, Michigan. The site is currently a heavily wooded area bounded by Belleville Lake to the south, and site grades generally slope toward the lake. Belleville Road bounds the property to the north, and surrounding properties are generally residential in nature. Ground surface elevations at the soil boring locations range from approximately 657.0 to 672.5 feet.

PREVIOUS INVESTIGATION

G2 Consulting Group, LLC performed an original geotechnical investigation at this site (G2 Project No. 250079, dated May 7, 2025) for a single-building layout that included pavements, retaining walls, underground utilities, and mast-arm traffic signals at the four corners of the intersection of Belleville Road and Quirk Road. That investigation consisted of eleven (11) soil borings (designated B-01 through B-11): four borings at the intersection corners extending to 25 feet, three borings within the proposed pavement areas extending to 10 feet, and four borings within the footprint of the then-proposed building extending to 30 feet. The original borings are separate from the supplemental borings presented in this report; where the same designations appear, they refer to different locations and investigations.

The original investigation encountered approximately 3 to 12 inches of topsoil, underlain locally by medium compact gravelly sand fill and stiff silty clay fill within the upper 2-1/2 to 3 feet, over native stiff to hard silty clay extending to the explored depths, with compact to very compact native silty sand present below the silty clay within several borings. Silty clay fill with an organic matter content of 6.9 percent was encountered within the upper 3 feet of original boring B-11 and was recommended for complete removal and replacement. Groundwater was generally encountered at depths ranging from 19-1/2 to 26 feet during drilling operations. The building layout has since been revised to two buildings, and a retaining wall, boardwalk, and boat dock/fishing pier have been added; the supplemental borings presented herein were performed to develop recommendations for the revised layout. For the proposed buildings, the nearest borings are supplemental borings B-01 and B-02 together with original borings B-08 through B-10.

SOIL AND GROUNDWATER CONDITIONS

Based upon the boring results and observations at the site, it appears that the general soil profile over most of the interior of the site consists of a topsoil layer of variable thickness over very stiff to hard clay soils extending to depths of nominally 20 feet below grade with underlying soils consisting of very compact silts, very stiff to hard clayey silts, and hard silty clays. The shoreline along Belleville Lake is armored with mixed rip rap type fill that includes broken concrete and other rubble. Similarly, the Belleville Road embankment, south of the park site and north of the road bridge, appears to be constructed of mixed granular fill including broken concrete and building rubble. Following is a detailed description of the soil profile at the boring locations.

Approximately 2 to 12 inches of topsoil are present at the ground surface of the borings. Fill soils consisting of sandy gravel with broken concrete and rubble are present below the topsoil within boring B-09, extending to a depth of 14 feet. Native silty clay underlies the fill within boring B-09 and the topsoil within the remaining borings, extending to the explored depths ranging from 10 feet (borings B-03 and B-04) to 49-1/2 feet (boring B-09). Native clayey silt is present at depth below the silty clay within borings B-01, B-02, B-05, B-06, and B-08. Within B-05, B-06, and B-08, native silt underlies the cohesive soils and extends to the explored depths.

The granular fill within boring B-09 is compact to very compact in relative density with SPT N-values ranging from 35 blows per foot (bpf) to 30 blows over 1 inch. The native silty clay is generally very stiff to hard in consistency, with

natural moisture contents ranging from 15 to 29 percent and unconfined compressive strengths ranging from 4,000 to 9,000 pounds per square foot (psf); however, stiff silty clay was encountered locally within borings B-02, B-07, B-08, and B-09 with unconfined compressive strengths ranging from 2,500 to 3,500 psf. The native clayey silt is very stiff to hard in consistency with natural moisture contents ranging from 20 to 29 percent and unconfined compressive strength ranging from 4,000 to 9,000 psf. The native silt is compact to very compact in relative density with SPT N-values ranging from 30 to 60 bpf.

Groundwater was encountered within borings B-01, B-05, B-08, and B-09 at depths ranging from 18-1/2 to 29 feet during drilling operations. Upon completion of drilling operations, groundwater was measured at depths ranging from 17-1/2 to 46-1/2 feet within these borings. No measurable groundwater was encountered within the remaining borings during or upon completion of drilling operations.

Fluctuations in perched and long-term groundwater levels should be anticipated due to seasonal variations and following periods of prolonged precipitation. Groundwater levels at the park site will be directly related to the water surface level in Belleville Lake. It should also be noted that groundwater observations made during drilling operations in the borings where predominantly cohesive soils are present are not necessarily indicative of the static groundwater level. This is due to the low permeability of such soils and the tendency of drilling operations to seal off the natural paths of groundwater flow.

The stratification depths shown on the soil boring logs represent the soil conditions at the boring locations. Variations may occur between borings. Additionally, the stratigraphic lines represent the approximate boundaries between soil types. The transitions may be more gradual than what are shown. We have prepared the boring logs on the basis of laboratory classification and testing as well as field logs of the soils encountered.

Soil profiles described above are generalized descriptions of the conditions encountered at the boring locations. General Notes Terminology defining the nomenclature used on the boring logs and elsewhere in this report are presented on Figure No. 10.

SITE PREPARATION

We anticipate earthwork operations will consist of brush clearing and tree removal; complete removal of existing topsoil within the footprints of the proposed buildings, pavements, and other improvements; proof-rolling the exposed cohesive subgrade; placing engineered fill to achieve final grades; and excavating for foundations. Based on the finished floor elevations and existing grades, up to approximately 3 to 4 feet of engineered fill is anticipated on the south sides of each building to achieve final grades. We recommend that all earthwork operations be performed in accordance with comprehensive specifications and be properly monitored in the field by qualified geotechnical engineers or technicians.

After site stripping, we anticipate the exposed subgrade will generally consist of native cohesive soils. The exposed cohesive subgrade soils should be proof-rolled with a fully loaded tandem-axle dump truck and visually evaluated for stability. Unsuitable soils exhibiting excessive instability, such as severe rutting, should be improved with additional compaction or undercut to expose stable soils. The sandy gravel fill with concrete debris and rubble encountered within boring B-09 is not considered suitable for support of settlement-sensitive structures and should be evaluated relative to the proposed improvements in that area.

The on-site native cohesive soils appear clean and are considered suitable for engineered embankment fill in a site grading operation. Embankment fill in a mass grading operation should be limited to low plasticity clays, silty clays, and clayey silt mixtures or poorly to well graded mixtures of sand and gravel. Highly organic soils, predominantly

silts (USCS Classification ML or MH), and high plasticity clay soils (CH Classification) should be avoided as embankment fill. Native clay soils along the project alignment may require break down and moisture conditioning (either drying or moisture addition) for effective compaction.

Although no boulders were encountered during the drilling operations for this study, boulders and nested cobbles are known to exist in the glacially deposited soils in the Southeastern Michigan area. Rubble fill is also present at the site. If encountered during the mass grading work boulders or rubble should be removed from the embankment fill prior to placement and compaction. The earthwork contractor is advised that random boulders may be encountered at this site.

Engineered fill should consist of an approved, environmentally clean material free of organic matter, frozen soil, clods, or other harmful substances. The fill should be placed in uniform horizontal layers not more than 9 inches in loose thickness and compacted to at least 95 percent of the maximum dry density determined by the Modified Proctor (ASTM D1557) method. Engineered fill should be placed and compacted at approximately the optimum moisture content. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade.

FOUNDATION RECOMMENDATIONS

We recommend the proposed Community Lakehouse and Lake Hall buildings be supported on conventional strip and spread footing foundations bearing on native very stiff to hard silty clay or engineered fill placed over native soils installed in accordance with the recommendations regarding embankment fill noted in the Site Preparation section of this report. Foundations bearing on the aforementioned soils may be designed using a net allowable soil bearing pressure of 3,000 pounds per square foot (psf).

Exterior footings should bear at a minimum depth of 3-1/2 feet below finished grade for protection against frost heave. Interior footings may bear at shallower depths, provided they are protected from frost during construction. Continuous wall or strip footing foundations should be at least 14 inches in width, and isolated spread footing foundations should be at least 30 inches in their least dimension. The sides of continuous footings should be constructed straight and vertical to reduce the risk of frozen soil adhering to the concrete and raising the foundations. All excavations should be backfilled with engineered fill when supporting overlying structures such as floor slabs and foundations.

Adjacent spread footings at different levels should be designed and constructed so that the least lateral distance between them is equivalent to or more than the difference in their bearing levels. To achieve a change in the level of a strip foundation, the foundation should be gradually stepped at a grade no steeper than two units horizontal to one unit vertical (2H:1V). We recommend all foundations be suitably reinforced to minimize the effects of differential settlements associated with local variations in soil conditions.

If the recommendations outlined in this report are adhered to, total and differential settlements for the completed structure should be within 1 inch and 1/2 inch, respectively. We expect settlements of these magnitudes are within tolerable limits for the type of structure proposed.

FLOOR SLAB RECOMMENDATIONS

In general, the native very stiff to hard silty clay and engineered fill placed over native soils are suitable for support of the proposed floor slabs, following satisfactory completion of a proof-roll as described in the Site Preparation section. Floor slabs supported by the native cohesive soils or engineered fill may be designed using a subgrade modulus of up to 125 pounds per cubic inch (pci).

We recommend at least 4 inches of clean coarse sand or pea gravel be placed between the subgrade and the bottom of the floor slab for use as a capillary break to reduce moisture transmission through the concrete floors and to reduce the potential for concrete curling. If moisture-sensitive floor coverings are planned or if greater protection against vapor transmission is desired, a vapor barrier consisting of 10-mil plastic sheeting, or equivalent, may be placed atop the sand layer beneath the floor slab. If a vapor barrier is used, the concrete curing conditions should be evaluated to minimize the possibility of concrete curling. The floor slab should be isolated from the foundation system to allow for independent movement.

RETAINING WALL RECOMMENDATIONS

A new block retaining wall with a maximum height of approximately 10 feet is proposed on the east side of the site in the vicinity of borings B-05 and B-06, where the subsurface soils generally consist of very stiff to hard native silty clay. Site subsurface conditions are suitable for conventional gravity block retaining wall structures consisting of conventional concrete retaining walls and reinforced earth retaining walls with modular block façade walls. Refer to our original geotechnical report, dated May 7, 2025, for recommendations for retaining wall design and construction.

BOARDWALK AND DOCK/FISHING PIER FOUNDATIONS

We understand the proposed boardwalk will be constructed slightly inland from the water's edge along Belleville Lake, and the proposed boat docks and fishing pier will be constructed on the west side of the lake. Concrete debris was observed along the slope of the lake edge, similar to the sandy gravel fill with concrete debris encountered within boring B-09 (extending to a depth of 14 feet) near the proposed dock and fishing pier. The estimated design load is 8 kips per pile, plus or minus 5 kips. We provide design recommendations for foundations using helical piles for the boardwalk, and driven steel piles for the fishing pier.

Helical Pile Recommendations

The ground surface along the shoreline of the park property drops off sharply to the water's edge. The ground surface elevation along the top of the slope is approximately 660 feet, and it appears the slope meets the water's edge at approximately elevation 645 feet. The slope angle appears to range from approximately 2(V):1(H) to 2-1/2 (V):1(H). The surface of the slope is armored with broken concrete and other materials.

We assume the boardwalk alignment will generally follow the top of the slope along shoreline. We assume the boardwalk will be timber structure supported on a series of bents with each bent founded on two or more helical piers. It is likely that installation of pier foundations will require pre-excavation of the broken concrete and other debris that is acting as shore protection.

We recommend the proposed boardwalk be supported on helical piers bearing within the native stiff to hard silty clay soils that exist along the shoreline and extend from below the surface materials to approximately elevation 641 feet. Steel helical piers are commonly used to support boardwalk structures. A variety of configurations are possible and many pier systems are proprietary, but in general, each pier consists of a tubular steel shaft with single or multiple helical plates attached to the shaft. The capacity of each pier in axial compression is a function of the structural capacity of the shaft to resist buckling and the sum of the soil bearing capacities of the plates. Single, double, or triple plate configurations are common with plate diameters ranging from 8 inches to 14 inches or larger.

We recommend the boardwalk employ a triple helix configuration with an 8-inch, 10 inch, and 12 inch diameter plates on a lead section that is 10-1/2 feet in length. The helical piers should extend such that all helix bear within the stiff to hard silty clay soils encountered at borings B-7 and B-8. Each lead section should be extended such that

the top helical plate is at least 48 inches below final site grades. We recommend using an allowable axial capacity of 10 kips per pile for the noted triple helix configuration. Smaller helix configurations will result in lower maximum capacities.

It is recommended that the contractor's bid and pay items include unit prices for lead sections, which include the helix bearing plates, with additional unit prices for extension sections that are required to extend each lead section to the final bearing elevation. It is recommended that the capacity of individual helical piers installed for the boardwalk be verified with a pile load test and production pile installation based upon the installation torque required as per the manufacturers and installers approved shop drawings. In general, soil strengths along the boardwalk alignment increase dramatically below approximately elevation 641 feet. It is anticipated that any piers that fail to achieve capacity based upon installation torque can be extended to or below approximately elevation 641 feet to achieve design capacity. Installation records including pile configuration, pile lengths, and installation torque measurements for each pile should be compiled during construction by a G2 engineer or technician.

Driven Steel Pile Recommendations

Loading conditions for the proposed fishing pier foundations were not available at the time of this report. However, we understand the fishing pier may be designed using driven steel piles. Steel pipe piles, driven open ended, are typically used to support docks and for boat mooring. Steel pipe pile diameters (O.D.) of 10-3/4 inches (wall thickness of 0.188 inches) or (O.D.) 12-3/4 inches (wall thickness of 0.250 inches) are common for dock and mooring piles.

It is recommended that open ended pipe piles be designed with estimated tip elevations of 630 feet. This will allow for approximately 5 feet of penetration into the hard silty clay soils encountered within boring B-9 below a depth of 22 feet. Steel pipe piles, nominally 10 inches in diameter, are expected to develop allowable vertical load capacities of 15 Kips per pile when installed to a tip elevation of 630 feet, and nominally 12 inch diameter pipe piles are expected to develop an allowable vertical capacity of 20 Kips per pile installed to this same tip elevation.

The piling contractor should submit a work plan that includes information on the pile driving system including the hammer and associated components for approval of the engineer prior to installation. Pile capacities should be verified during installation using an approved dynamic pile driving equation or by other approved methods.

It is anticipated that installation of driven piling on the Belleville Road embankment will be difficult because the embankment contains broken concrete and other building rubble. It may be possible to prebore the pile locations but it is likely that at least partial excavation will be necessary. The contractor should maintain a stable open hole to the bottom of the bore. It is anticipated that excavation or preboring to approximately elevation 643 feet or deeper will be required to maintain clearance for piling installation.

G2 should be consulted after the fishing dock plans are more developed in order to review these recommendations with respect to the latest plans.

INFILTRATION EVALUATION

The cohesive soils encountered throughout the site, and in particular, within the area of the proposed stormwater detention, are unsuitable for infiltration due to their low permeability rates. Due to the lack of suitable soils for infiltration testing, no infiltration testing was performed during our field investigation. We recommend the on-site fill and native cohesive soil be considered as having an infiltration rate of less than 0.1 in/hr. We recommend the underground detention system be designed for storage and controlled discharge rather than infiltration.

CONSTRUCTION CONSIDERATIONS

We do not anticipate that comprehensive dewatering measures will be required to maintain dry excavations for building foundations and shallow underground utilities. Nevertheless, any groundwater or surface runoff should be controllable with normal pumping from properly constructed internal sumps. Site grades should be maintained to direct surface water runoff away from open excavations or building pads. Groundwater should not be allowed to pond within any excavation for extended periods of time.

For excavations that extend below a depth of 5 feet and are to be entered, we recommend a maximum slope of 3/4 horizontal unit to 1 vertical unit (3/4H:1V) within very stiff to hard cohesive soils and 1H:1V within stiff cohesive soils. Where seepage from excavation cuts is observed, the slopes must be flattened sufficiently to achieve stability, but in no case left steeper than 3H:1V at and below the seepage level. Excavations should not extend below the groundwater level without prior dewatering. All excavations should be safely sheeted, shored, sloped, or braced in accordance with MI-OSHA requirements. If material is stored or equipment is operated near an excavation, stronger shoring must be used to resist the extra pressure due to the superimposed loads.

Excavations for foundations and underground utilities within the influence of buildings, structures, or pavements should be backfilled with well graded granular soils meeting MDOT Class IIA grading requirements. Soils meeting these requirements are not available on-site and will have to be imported. Engineered backfill should be placed in uniform lifts not exceeding 12 inches, and each lift should be compacted using suitable vibratory equipment to not less than 95 percent of the maximum dry density as determined by the Modified Proctor (ASTM D1557) method.

GENERAL COMMENTS

The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated on the Soil Boring Location Plan, Plate No. 1, and the project information provided to us. This report does not reflect any variations which may occur between these borings. The nature and extent of such variations may not become evident until construction. If variations appear, we should be retained to re-evaluate the recommendations of this report and modify them, if necessary.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Our scope of services was limited to evaluation of the subsurface conditions as they relate to the geotechnical support of the proposed construction; no chemical, environmental, or hydrogeological testing was performed.

In the event that any changes in the design, location, or concept of the project are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing by G2 Consulting Group, LLC. We recommend that G2 be retained to observe and test the site preparation, engineered fill placement, foundation installation, and other geotechnical-related construction activities to confirm that the subsurface conditions are consistent with those encountered in our borings and that our recommendations are properly implemented.

APPENDIX

SOIL BORING LOCATION PLAN	PLATE NO. 1
SOIL BORING LOGS	FIGURE NOS. 1 THROUGH 9
GENERAL NOTES TERMINOLOGY	FIGURE NO. 10

Legend

Soil borings drilled by Strata Drilling, Inc. on June 24-25, 2026.
B-1 and B-2 - Building (20 feet)
B-3 and B-4 - Infiltration (10 feet)
B-5 and B-6 - Retaining Wall (30 feet)
B-7 and B-8 - Boardwalk (20 feet)
B-9 – Pier (49-½ feet)

Soil Borings performed within Preliminary Investigation

Supplemental Soil Boring Location Plan

Lakeside Park (Proposed Lake House Facility)
Belleville Road at Quirk Road
Van Buren Township, Michigan

CONSULTING GROUP
Smart.Results.Fast.

Project No. 250079s	
Drawn by: RPC	
Date: 7/15/26	Plate No. 1
Scale: NTS	

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.213060° Longitude: -83.491078°

Soil Boring No. B-01

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 661.0 ft ±

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Silty Clay (2 inches)	
656.0		Very Stiff to Hard Brown Silty Clay with trace sand and gravel	5
		653.0 — 8.0	
651.0		Hard Brown and Gray Silty Clay with trace sand and gravel — 651.0 — 10.0	10
		Hard Brown Silty Clay with trace sand and gravel — 647.0 — 14.0	
646.0		Hard Gray Silty Clay with trace sand and gravel — 644.5 — 16.5	15
		Hard Brown and Gray Silty Clay with trace sand and gravel — 18.5	
641.0		Very Stiff Gray Clayey Silt with trace sand and gravel — 20.0	20
		End of Boring @ 20 ft	
636.0			25
631.0			30
626.0			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	4 7 9	16	16.6		5000*
S-02	5 9 13	22	17.0		7000*
S-03	10 12 15	27	18.8		9000*
S-04	6 18 15	33	18.2		9000*
S-05	3 10 16	26	16.8		8000*
S-06	3 5 7	12	28.9		4000*

Total Depth: 20 ft
Drilling Date: June 25, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: B. Sienkiewicz

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
18-1/2 feet during drilling operations; 19-1/2 feet upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 1

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.213337° Longitude: -83.490152°

Soil Boring No. B-02

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 664.0 ft ±

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Silty Clay (2 inches)	
		Stiff Brown Silty Clay with trace sand and gravel (661.0 – 3.0)	
659.0		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel (656.5 – 7.5)	5
654.0		Hard Brown Silty Clay with trace sand and gravel, occasional sand seams (652.0 – 12.0)	10
649.0		Very Stiff Gray Silty Clay with trace sand and gravel (645.0 – 19.0)	15
644.0		Very Stiff Gray Clayey Silt with trace sand and gravel (644.0 – 20.0)	20
		End of Boring @ 20 ft	
639.0			25
634.0			30
629.0			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	4 6 5	11	18.4		3500*
S-02	5 8 15	23	15.0		7000*
S-03	5 10 16	26	18.7		8000*
S-04	6 12 15	27	16.2		8500*
S-05	4 6 10	16	18.1		5000*
S-06	4 6 7	13	25.6		4000*

Total Depth: 20 ft
Drilling Date: June 25, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: B. Sienkiewicz

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 2

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.213239° Longitude: -83.491343°

Soil Boring No. B-03

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 664.5 ft ±

663.5 — Topsoil: Dark Brown Silty Clay (12 inches) — 1.0

Very Stiff to Hard Brown Silty Clay with trace sand and gravel

654.5 — 10.0

End of Boring @ 10 ft

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 5 6	11	16.8		4000*
S-02	2 4 9	13	19.6		4000*
S-03	15 18 28	46	18.5		9000*
S-04	8 13 18	31	16.6		9000*

ELEV. (ft): 659.5, 654.5, 649.5, 644.5, 639.5, 634.5, 629.5

DEPTH (ft): 5, 10, 15, 20, 25, 30, 35

Total Depth: 10 ft
Drilling Date: June 24, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: J. Haynor

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 3

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.213021° Longitude: -83.490622°

Soil Boring No. B-04

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 661.0 ft ±

Topsoil: Dark Brown Silty Clay (4 inches)

Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel

End of Boring @ 10 ft

SOIL SAMPLE DATA

ELEV. (ft)	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
651.0 (10.0)		S-01	4 6 7	13	17.8		4000*
656.0	5	S-02	4 5 12	17	17.8		6000*
		S-03	5 12 16	28	18.4		9000*
651.0	10	S-04	8 12 15	27	18.6		8500*
646.0	15						
641.0	20						
636.0	25						
631.0	30						
626.0	35						

Total Depth: 10 ft
Drilling Date: June 24, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: J. Haynor

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.213567° Longitude: -83.490052°

Soil Boring No. B-05

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 672.5 ft ±

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		671.8 Topsoil: Dark Brown Silty Clay (8 inches) 0.7	
		Very Stiff to Hard Brown Silty Clay with trace sand and gravel	
667.5			5
662.5			10
		659.5 13.0	
657.5		Hard Gray Silty Clay with trace sand and gravel	15
652.5			20
		648.5 24.0	
647.5		Very Stiff Gray Silty Clay with trace sand and gravel, frequent sand and gravel seams	25
		646.5 26.0	
		Very Stiff Gray Clayey Silt with trace sand and gravel 28.5	
642.5		Very Compact Gray Silt with trace clay, sand, and gravel 30.0	30
		End of Boring @ 30 ft	
637.5			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 5 6	11	16.4		4000*
S-02	5 9 10	19	19.7		6000*
S-03	6 9 14	23	17.5		7000*
S-04	9 14 22	36	18.8		9000*
S-05	7 12 15	27	17.5		8500*
S-06	8 10 14	24	16.2		7000*
S-07	4 5 6	11	16.5		4000*
S-08A					
S-08B	5 21 39	60			

Total Depth: 30 ft
Drilling Date: June 25, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: B. Sienkiewicz

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
29 feet during drilling operations; 29-1/2 feet upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 5

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.213190° Longitude: -83.489947°

Soil Boring No. B-06

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 662.0 ft ±

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		661.3 Topsoil: Dark Brown Silty Clay (8 inches) 0.7	
		Very Stiff Brown Silty Clay with trace sand and gravel 659.0 3.0	
657.0			5
		Very Stiff Molted Brown and Gray Silty Clay with trace sand and gravel 648.0 14.0	
652.0			10
647.0			15
		Very Stiff Gray Silty Clay with trace sand and gravel 644.0 18.0	
642.0		Hard Gray Silty Clay with trace sand and gravel, frequent silt seams 641.0 21.0	20
637.0		Very Compact Gray Silt with trace sand and gravel 635.0 27.0	25
632.0		Hard Gray Clayey Silt with trace sand and gravel 632.0 30.0	30
627.0		End of Boring @ 30 ft	35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 5 6	11	17.8		4000*
S-02	7 11 13	24	19.2		7000*
S-03	5 9 12	21	18.2		6000*
S-04	5 9 15	24	20.2		7500*
S-05	4 5 9	14	18.0		4500*
S-06	4 7 24	31	20.6		9000*
S-07	11 22 39	61			
S-08	7 15 19	34	19.7		9000*

Total Depth: 30 ft
Drilling Date: June 24, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: J. Haynor

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.212960° Longitude: -83.490250°

Soil Boring No. B-07

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 661.0 ft ±

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		660.3 Topsoil: Dark Brown Silty Clay (8 inches) 0.7	
656.0		Very Stiff Brown Silty Clay with trace sand and gravel	5
		652.0 9.0	
651.0			10
		Very Stiff Brown and Gray Silty Clay with trace sand and gravel	
		647.5 13.5	
646.0			15
		Stiff Gray Silty Clay with trace sand and gravel	
641.0		641.0 20.0	20
		End of Boring @ 20 ft	
636.0			25
631.0			30
626.0			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 5 7	12	15.9		4000*
S-02	5 7 10	17	17.5		5000*
S-03	5 8 14	22	17.9		6500*
S-04	5 8 12	20	16.9		6000*
S-05	3 4 6	10	18.2		3000*
S-06	3 5 6	11	17.1		3500*

Total Depth: 20 ft
Drilling Date: June 24, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: J. Haynor

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.212968° Longitude: -83.491419°

Soil Boring No. B-08

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 659.0 ft ±

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Silty Clay (2 inches)	
654.0		Stiff to Very Stiff Brown Silty Clay with trace sand and gravel	5
		651.0 — 8.0	
649.0			10
644.0		Very Stiff to Hard Gray Silty Clay with trace sand and gravel	15
		18.0	
639.0		Compact Gray Silt with trace clay, sand, and gravel — 639.0 — 20.0	20
		End of Boring @ 20 ft	
634.0			25
629.0			30
624.0			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 4 6	10	17.5		3000*
S-02	5 7 10	17	16.7		5000*
S-03	9 10 14	24	16.9		7000*
S-04	8 12 17	29	19.2		9000*
S-05	3 5 9	14	17.7		4500*
S-06	12 14 25	39			

Total Depth: 20 ft
Drilling Date: June 25, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: B. Sienkiewicz

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
19 feet during drilling operations; 17-1/2 feet upon completion

Notes:
Borehole collapsed at 18-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 8

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.212649° Longitude: -83.491877°

Soil Boring No. B-09

G2 CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 657.0 ft ±

ELEV. (ft)	PRO-FILE		DEPTH (ft)
		656.0 — Topsoil: Dark Brown Silty Clay (12 inches) — 1.0	
652.0		Fill: Compact to Very Compact Brown Sandy Gravel with concrete debris, occasional topsoil seams	5
647.0			10
642.0		643.0 — 14.0	15
		Stiff Gray Silty Clay with trace sand and gravel	
637.0		639.0 — 18.0	20
		Very Stiff Brown Silty Clay with trace sand and gravel, occasional sand and silt seams	
632.0		635.0 — 22.0	25
627.0		Hard Gray Silty Clay with trace sand and gravel; occasional silt seams	30
622.0			35

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
AS-01					
S-02	6 30/3	---			
S-03	10 7 30/1	---			
S-04	1 10 25	35			
S-05	14 4 4	8	17.9		2500*
S-06	5 8 14	22	17.4		6000*
S-07	15 17 24	41	17.2		9000*
S-08	10 14 21	35	16.0		9000*
S-09	9 13 16	29	16.2		9000*

Total Depth: 49.5 ft
Drilling Date: June 25, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: B. Sienkiewicz

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
28 feet during drilling operations; 46-1/2 feet upon competion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 9a

Project Name: Proposed Lake House Facility

Project Location: Belleville Road @ Quirk Road
Van Buren Township , Michigan

G2 Project No. 250079s

Latitude: 42.212649° Longitude: -83.491877°

Soil Boring No. B-09

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 657.0 ft ±

Hard Gray Silty Clay with trace sand and gravel; occasional silt seams (continued)

607.5 — 49.5

End of Boring @ 49.5 ft, Auger Refusal

SOIL SAMPLE DATA

ELEV. (ft)	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
617.0	40	S-10	7 18 16	34	17.6		9000*
612.0	45	S-11	15 18 16	34	21.5		9000*
607.0	50						
602.0	55						
597.0	60						
592.0	65						
587.0	70						

Total Depth: 49.5 ft
Drilling Date: June 25, 2026
Inspector: J. Bowles
Contractor: Strata Drilling, INC.
Driller: B. Sienkiewicz

Drilling Method:
4-1/4 inch Hollow stem augers

Water Level Observations:
28 feet during drilling operations; 46-1/2 feet upon competion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 9b

GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM D 653.

PARTICLE SIZE

Boulders		- greater than 12 inches
Cobbles		- 3 inches to 12 inches
Gravel	- Coarse	- 3/4 inches to 3 inches
	- Fine	- No. 4 to 3/4 inches
Sand	- Coarse	- No. 10 to No. 4
	- Medium	- No. 40 to No. 10
	- Fine	- No. 200 to No. 40
Silt		- 0.005mm to 0.074mm
Clay		- Less than 0.005mm

CLASSIFICATION

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent (percent by weight)	**Minor Constituent (percent by weight)**
Trace - 1 to 12%	Trace - 1 to 12%
Adjective - 12 to 35%	Little - 12 to 23%
And - over 35%	Some - 23 to 33%

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier, i.e. sandy clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils, i.e. silty clay, trace sand, little gravel.

Consistency	**Unconfined Compressive Strength (psf)**	**Approximate Range of (N)**
Very Soft	Below 500	0 - 2
Soft	500 - 1,000	3 - 4
Medium	1,000 - 2,000	5 - 8
Stiff	2,000 - 4,000	9 - 15
Very Stiff	4,000 - 8,000	16 - 30
Hard	8,000 - 16,000	31 - 50
Very Hard	Over 16,000	Over 50

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

COHESIONLESS SOILS

Density Classification	**Relative Density %**	**Approximate Range of (N)**
Very Loose	0 - 15	0 - 4
Loose	16 - 35	5 - 10
Medium Compact	36 - 65	11 - 30
Compact	66 - 85	31 - 50
Very Compact	86 - 100	Over 50

Relative Density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

SAMPLE DESIGNATIONS

AS - Auger Sample – Cuttings directly from auger flight
BS - Bottle or Bag Samples
S - Split Spoon Sample - ASTM D 1586
LS - Liner Sample with liner insert 3 inches in length
ST - Shelby Tube sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0 inch outside-diameter, 1-3/8 inch inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

END OF SECTION 00 31 32

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SECTION 00 41 13 – BID - STIPULATED SUM

Bid of _____ hereinafter called Bidder, organized and existing under the laws of or a resident of the State of _____, doing business as _____.*

*Insert as applicable: "a corporation", "a partnership" or "an individual".

To Fishbeck, hereinafter called Construction Manager.

ARTICLE 1 – BID RECIPIENT

1.01 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Fishbeck in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Advertisement for Bids and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request by Construction Manager.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents, as set forth in the Agreement, that:

A. Bidder has examined and carefully studied the Bidding Documents, other related data identified in the Bidding Documents, and the following Addenda, receipt of all which is hereby acknowledged:

Addendum Number	Addendum Date
_____	_____
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and is satisfied as to Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all:

(1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that have been provided with this project manual.

(2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Construction Documents.

E. Bidder has considered the information known to Bidder; information commonly known to Subcontractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on:

(1) the cost, progress, and performance of the Work;

(2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and

(3) Bidder's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

H. Bidder has given Construction Manager written notice of all conflicts, errors, ambiguities or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Construction Manager is acceptable to Bidder.

I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

(1) "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;

(2) "fraudulent practice" means an intentional misrepresentation of facts made

(a) to influence the bidding process to the detriment of Owner/ Construction Manager,

(b) to establish bid prices at artificial non-competitive levels, or

(c) to deprive Owner/Construction Manager of the benefits of free and open competition;

(3) "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Construction Manager, a purpose of which to establish bid prices at artificial non-competitive levels; and

(4) "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following prices:

BID CATEGORY 03-100 - Concrete:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 04-100 - Masonry:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 05-100 - Structural Steel and Miscellaneous Metals:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 05-200 - Canopy/Skyring Installation (NOTE: Owner has Pre-selected ICON/webuildfun):

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 06-100 - General Trades:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

_____
Bidder (Firm or Corporation Name)

BID CATEGORY 07-100 - Roofing:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 08-100 - Storefronts and Glazing:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 09-100 - Painting:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 09-300 - Flooring and Tile:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 21-100 - Fire Suppression:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

_____
Bidder (Firm or Corporation Name)

BID CATEGORY 23-100 - Plumbing, Heating, Ventilation, and Air Conditioning:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 26-100 – Electrical, Fire Alarm, and Audio Visual:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 31-100 – Earthwork and Site Utilities:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 32-100 – Landscaping:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

BID CATEGORY 35-100 – Boardwalk, Boat Docks, and Fishing Pier:

Base Bid _____ ($_____)
(use words) (figures)

Bond cost included in base bid above:

_____($_____)
(use words) (figures)

All specific cash allowances are included in the price(s) set forth above.

_____
Bidder (Firm or Corporation Name)

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that the work will be substantially complete on or before the dates shown on the construction schedule in Division 01 Section "Summary of Work."

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.01 The following documents are submitted with and made a condition of this Bid:

A. Evidence of authority to sign Bid, if Bid is submitted by a corporation, partnership or joint venture;

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings indicated in the Instructions to Bidders.

ARTICLE 9 – BID SUBMITTAL

9.01 This Bid is submitted by:

SUBMITTED on_____, 20___
Date*

BY: _____
Name of Bidder*

_____
Business Street Address*

_____
Signature

_____
City, State, and Zip*

_____
Name and Title of Signatory*

_____
Telephone Number*

_____
E-mail Address*

*Typed or printed in ink.

END OF SECTION 00 41 13

SECTION 00 51 00 – NOTICE OF AWARD

Dated _____, 20____

TO: _____
(Bidder)

ADDRESS: _____

_____

CONTRACT: Van Buren Charter Township – The Lakeside Park
Van Buren Township, Michigan
Project Number 2500281

You are notified that your Bid dated _____, 20____ for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract for The Lakeside Park.

The Contract Price of your Contract is _____
_____ Dollars
($_____). [Two] [ ] copies of the proposed Contract Documents as identified in the Agreement accompany this Notice of Award.

You must comply with the following conditions precedent within 15 days of the date of this Notice of Award, that is by _____, 20____.

1. Deliver to the Owner a fully executed counterparts of the Contract Documents which accompany this Notice of Award, each of which must bear your signature at the designated location.

2. Deliver with the Executed Contract Documents the insurance documents as specified in the Agreement (Article 9.2).

3. Deliver with the Executed Contract Documents the Contract security (bonds) as specified in the Agreement (Article 9.3)

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within 10 days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Contract Documents.

Van Buren Charter Township

By: _____
(Authorized Signature)

_____
(Name and Title)

*Typed or printed in ink

Copy to Engineer

END OF SECTION 00 51 00

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SECTION 00 52 00 – AGREEMENT

Beginning of Agreement

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ConsensusDocs® 750

STANDARD AGREEMENT BETWEEN CONSTRUCTOR AND SUBCONTRACTOR

DRAFT

TABLE OF ARTICLES

1. AGREEMENT
2. SCOPE OF WORK
3. SUBCONTRACTOR'S RESPONSIBILITIES
4. CONSTRUCTOR'S RESPONSIBILITIES
5. PROGRESS SCHEDULE
6. SUBCONTRACT AMOUNT
7. CHANGES
8. PAYMENT
9. INDEMNITY, INSURANCE, AND BONDS
10. SUSPENSION, NOTICE TO CURE, AND TERMINATION
11. DISPUTE RESOLUTION
12. MISCELLANEOUS
13. SUBCONTRACT DOCUMENTS

ARTICLE 1 AGREEMENT

Project Number: 2500281

This Agreement is made this _____ Day of _____ in the year [_____], by and between the

CONSTRUCTOR,
Fishbeck
1515 Arboretum Drive SE
Grand Rapids, Michigan 49546

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and the

SUBCONTRACTOR,
NAME
ADDRESS
ADDRESS

Tax identification number (TIN) _____
Contractor License No., if applicable _____

For services in connection with the Subcontract Work for Bid Category _____ for the following

PROJECT: Van Buren Charter Township Lakeside Park

Owner is Van Buren Charter Township,

and the Design Professional is Fishbeck.

ARTICLE 2 SCOPE OF WORK

2.1 PARTIES RELATIONSHIP Each Party agrees to act on the basis of mutual trust, good faith, and fair dealing. The Parties shall each endeavor to promote harmony and cooperation, and perform in an economical and timely manner.

2.1.1 ETHICS Each Party shall perform with integrity. Each shall: (a) avoid conflicts of interest; and (b) promptly disclose to the other Party any conflicts that arise. Each Party warrants that it has not and shall not pay nor receive any contingent fees or gratuities to or from the other Party, including its agents, officers, employees, subcontractors or others for whom they may be liable, to secure preferential treatment.

2.2 SUBCONTRACT WORK Constructor contracts with Subcontractor as an independent contractor to provide all labor, materials, equipment, and services necessary to complete the Subcontract Work in accordance with, and reasonably inferable from, the Subcontract Documents, and consistent with the Progress Schedule, as may change from time to time. Subcontractor shall perform the Subcontract Work under Constructors general direction and in accordance with the Subcontract Documents.

2.3 CONSTRUCTORS WORK Constructors Work is the construction and services required of Constructor to fulfill its obligations pursuant to its agreement with Owner (the Work). The “Subcontract Work” is a portion of Constructors Work.

2.4 SUBCONTRACT DOCUMENTS The Subcontract Documents include this Agreement, the Prime Agreement, special conditions, general conditions, specifications, drawings, addenda issued and acknowledged before execution of this Agreement, amendments, laboratory testing that are Contract Documents, other documents listed in this Agreement, and modifications issued in accordance with this Agreement. Constructor shall provide to Subcontractor, before the execution of this Agreement, copies of the existing Subcontract Documents. Subcontractor shall provide copies of applicable portions of the Subcontract Documents to its proposed subcontractors and suppliers. Nothing shall prohibit Subcontractor from obtaining copies of the Subcontract Documents from Constructor at any time after the Subcontract Agreement is executed.

2.4.1 ELECTRONIC DOCUMENTS If Owner requires that Owner, Design Professional, Constructor, and Subcontractors exchange documents and data in electronic or digital form, before any such

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exchange, Owner, Design Professional, and Constructor shall agree on and follow a written protocol, which at minimum, shall specify: (a) the definition of documents and data to be accepted in electronic or digital form or to be transmitted electronically or digitally; (b) management and coordination responsibilities; (c) necessary equipment, software, and services; (d) acceptable formats, transmission methods, and verification procedures; (e) methods for maintaining version control; (f) privacy and security requirements; and (g) storage and retrieval requirements. Subcontractor shall provide whatever input is needed to assist Constructor in developing the protocol and shall be bound by the requirements of the written protocol. Except as otherwise agreed upon in writing, the Parties shall each bear their own costs as identified in the protocol. In the absence of a written protocol, use of documents and data in electronic or digital form shall be at the sole risk of the recipient.

2.5 CONFLICTS In the event of a conflict between this ConsensusDocs 750 Standard Agreement as modified and the other Subcontract Documents, the ConsensusDocs 750 shall govern.

2.6 DEFINITIONS

2.6.1 “Agreement” means this ConsensusDocs 750 Standard Agreement Between Constructor and Subcontractor, as modified by the Parties, and exhibits and attachments made part of this agreement upon its execution.

2.6.1.1 The following exhibits are as follows:

Exhibit A: The Bid dated [_____].
Exhibit B: The Drawings, Specifications, General and Other Conditions dated [_____], addenda, and other information.
Exhibit C: Progress Schedule.
Exhibit D: Alternates and Unit Prices and Estimated Quantities.
Exhibit E: Insurance Documents.
Exhibit F: Bonds.
Exhibit G: Labor Relations.

2.6.2 “Business Day” means all Days, except weekends and official federal or state holidays where the Project is located.

2.6.3 The term “Day” shall mean calendar day.

2.6.4 Not Used

2.6.5 “Law” means a federal, state, or local law, ordinance, code, rule, or regulation applicable to the Subcontract Work with which a Party must comply that is enacted as of the Agreement date.

2.6.6 The “Parties” are collectively Constructor and Subcontractor.

2.6.7 “Prime Agreement” means the agreement between Constructor and Owner for the construction of the Project.

2.6.8 A “Subcontract Change Order” is a written order signed by The Parties after execution of this Agreement, indicating changes in the scope of the Subcontract Work, the Subcontract Amount, or Subcontract Time, including substitutions proposed by Subcontractor and accepted by Constructor.

2.6.9 “Subcontract Time” means the time period on the Progress Schedule between commencing and completing the Subcontract Work.

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DRAFT

2.6.10 “Worksite” means the geographical area of the Project location as identified in the design documents where the Work is to be performed.

2.6.11 The term “Constructor” within this agreement shall mean Construction Manager within the Division 0 and Division 1 specification sections.

ARTICLE 3 SUBCONTRACTOR’S RESPONSIBILITIES

3.1 OBLIGATIONS The Parties are mutually bound by the terms of this Agreement. To the extent the terms of the Prime Agreement apply to the Subcontract Work, then Constructor assumes toward Subcontractor all the obligations, rights, duties, and redress that Owner under the Prime Agreement assumes toward Constructor. In an identical way, Subcontractor hereby assumes toward Constructor all the same obligations, rights, duties, and redress that Constructor assumes toward Owner and Design Professional under the Prime Agreement. In the event of an inconsistency among the documents, the specific terms of this Agreement shall govern.

3.2 RESPONSIBILITIES Subcontractor shall furnish its diligent efforts to perform the Subcontract Work in an expeditious manner and to cooperate with Constructor so that Constructor may fulfill its obligations to Owner. Subcontractor shall furnish all of the labor, materials, equipment, and services, including but not limited to competent supervision, shop drawings, samples, tools, and scaffolding as are necessary for the proper performance of the Subcontract Work, all of which shall be provided in full accord with and reasonably inferable from the Subcontract Documents. Subcontractor shall provide Constructor a list of its proposed subcontractors and suppliers, and be responsible for taking field dimensions, providing tests, obtaining required permits related to the Subcontract Work and affidavits, ordering of materials, and all other actions as required to meet the Progress Schedule.

3.3 INCONSISTENCIES AND OMISSIONS Subcontractor shall examine and compare the drawings, specifications, other Subcontract Documents, and information furnished by Owner relative to the Subcontract Work. Such examination and comparison shall be solely for the purpose of facilitating the Subcontract Work and not for the discovery of errors, inconsistencies, or omissions in the Subcontract Documents nor for ascertaining if the Subcontract Documents are in accordance with Laws. Subcontractor shall not have liability for errors, omissions, or inconsistencies discovered under this subsection unless Subcontractor knowingly fails to report a recognized problem to Constructor. Should Subcontractor discover any errors, inconsistencies, or omissions in the Subcontract Documents, Subcontractor shall promptly report such discoveries to Constructor in writing. Following receipt of written notice, Constructor shall promptly instruct Subcontractor as to the measures to be taken, and Subcontractor shall comply with Constructor’s instructions. If Subcontractor performs work knowing it to be contrary to Laws without notice to Constructor and advance approval by appropriate authorities, including Constructor, Subcontractor shall assume responsibility for such work and bear all associated costs, charges, fines, penalties, fees, and expenses necessarily incurred to remedy the violation. Subcontractor may be entitled to additional costs or time because of clarifications or instructions arising out of Subcontractor’s reports described in this section. Nothing in this section shall relieve Subcontractor of responsibility for its own errors, inconsistencies, and omissions.

3.4 WORKSITE VISITATION Before commencing the Subcontract Work, Subcontractor shall examine and compare the Subcontract Documents, relevant field measurements made by Subcontractor or shared by Constructor, and any visible conditions at the Worksite affecting the Subcontract Work. If Subcontractor discover any errors, omissions, or inconsistencies in the Subcontract Documents or between its Worksite observations and the Subcontract Documents, such discrepancies shall be promptly reported to Constructor.

3.5 INCREASED COSTS OR TIME Subcontractor may assert a claim if Constructor’s clarifications or instructions in response to requests for information are believed to require additional time or cost. If

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Subcontractor fails to perform the reviews and comparisons required in §3.3 and §3.4, to the extent Constructor is held liable to Owner because of Subcontractor's failure, Subcontractor shall pay the costs and damages to Constructor that would have been avoided if Subcontractor had performed those obligations.

3.6 COMMUNICATIONS Except as otherwise provided in the Subcontract Documents or for emergencies, Subcontractor shall direct Project-related communications to Constructor.

3.7 SUBMITTALS

3.7.1 Subcontractor promptly shall submit for approval to Constructor all shop drawings, samples, product data, manufacturers' literature, and similar submittals required by the Subcontract Documents. Submittals shall be submitted in electronic form if required. Subcontractor shall be responsible to Constructor for the accuracy and conformity of its submittals to the Subcontract Documents. Subcontractor shall prepare and deliver its submittals to Constructor in a manner consistent with the Progress Schedule and in such time and sequence so as not to delay Constructor or others in the performance of the Work, but not later than thirty (30) days after notice to proceed has been issued, unless a revised submittal schedule has been approved by the Constructor. Subcontractor's submittals shall identify in writing for each submittal all changes, deviations, or substitutions from the requirements of the Subcontract Documents. The approval of any Subcontractor submittal shall not be deemed to authorize changes, deviations, or substitutions in the requirements of the Subcontract Documents unless express written approval is obtained from Constructor and Owner authorizing such change, deviation, or substitution. Such approval shall be promptly memorialized in a Subcontract Change Order within seven (7) Days following approval by Constructor and, if applicable, provide for an adjustment in the Subcontract Amount or Subcontract Time. If the Subcontract Documents do not contain submittal requirements pertaining to the Subcontract Work, Subcontractor agrees upon request to submit in a timely fashion to Constructor for approval any shop drawings, samples, product data, manufacturers' literature, or similar submittals as may reasonably be required by Constructor, Owner, or Design Professional.

3.7.2 Constructor, Owner, and Design Professional are entitled to rely on the adequacy, accuracy, and completeness of any professional certifications required by the Subcontract Documents concerning the performance criteria of systems, equipment, or materials, including all relevant calculations and any governing performance requirements.

3.8 DESIGN DELEGATION

3.8.1 If the Subcontract Documents specify that Subcontractor is responsible for the design of a particular system or component for Project incorporation, then all design and performance criteria shall be specified. Subcontractor shall not be responsible for the adequacy of such performance and design criteria. Subcontractor shall be responsible for conformance of its design with the information given and the design concept expressed in the Subcontract Documents. As required by the Law, Subcontractor shall procure design services and necessary certifications from licensed design professionals. The signature and seal of Subcontractor's design professional shall appear on all drawings, calculations, specifications, certifications, shop drawings, and other submittals related to the Subcontract Work designed or certified by Subcontractor's design professional. Constructor shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by Subcontractor's design professional.

3.8.2 Subcontractor's design professional(s) is _____. If Subcontractor's design professional is an independent professional, the design services shall be procured pursuant to a separate agreement between Subcontractor and the design professional. The agreement between Subcontractor and Subcontractor's design professional shall not include any

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limitation of liability, except to the extent that consequential damages are waived pursuant to §5.4.1, or exclusion from participation in the multiparty proceedings requirement of §11.4. Subcontractor shall notify Constructor in writing if it intends to change its procured design professional.

3.9 COORDINATION Subcontractor shall: (a) cooperate with Constructor and others whose work may interface with the Subcontract Work, (b) specifically note and immediately advise Constructor of any such interface with the Subcontract Work, and (c) participate in preparing coordination drawings and work schedules in congested areas.

3.10 SUBCONTRACTOR'S REPRESENTATIVE Subcontractor's authorized representative is _____. This person shall possess full authority to receive and act upon instructions, orders, or directions. If Subcontractor changes its representative, or the representative's authority, Subcontractor shall immediately notify Constructor in writing.

3.11 TESTS AND INSPECTIONS Subcontractor shall schedule all required tests, approvals, and inspections of the Subcontract Work at appropriate times so as not to delay the progress of the Work or other work related to the Project. Subcontractor shall give proper written notice to all required Parties of such tests, approvals, and inspections. Except as otherwise provided in the Subcontract Documents, Subcontractor shall bear all expenses associated with tests, inspections, and approvals required of Subcontractor by the Subcontract Documents, which shall be conducted by an independent testing laboratory or entity approved by Constructor and Owner. Required certificates of testing, approval, or inspection shall, unless otherwise required by the Subcontract Documents, be secured by Subcontractor and promptly delivered to Constructor.

3.12 WARRANTIES Subcontractor warrants that all materials and equipment shall be new unless otherwise specified, of good quality, in conformance with the Subcontract Documents, and free from defective workmanship and materials. Upon request by Constructor, Subcontractor shall furnish satisfactory evidence of the quality and type of materials and equipment furnished. Subcontractor further warrants that the Subcontract Work shall be free from material defects not intrinsic in the design or materials required in the Subcontract Documents. Subcontractor's warranty does not include remedies for defects or damages caused by normal wear and tear during normal usage, use for a purpose for which the Project was not intended, improper or insufficient maintenance, modifications performed by others, or abuse. Subcontractor's warranties shall commence on the date of Substantial Completion of the Work or a designated portion.

3.13 CLEANUP

3.13.1 Subcontractor shall at all times during its performance of the Subcontract Work keep the Worksite clean and free from debris resulting from the Subcontract Work. Before discontinuing the Subcontract Work in an area, Subcontractor shall clean the area and remove all its rubbish and its construction equipment, tools, machinery, waste, and surplus materials. Subcontractor shall make provisions to minimize and confine dust and debris resulting from its construction activities. Subcontractor shall not be held responsible for unclean conditions caused by others.

3.13.2 If Subcontractor fails to commence compliance with cleanup duties within two (2) Business Days after written notification from Constructor of non-compliance, Constructor may implement appropriate cleanup measures without further notice and shall deduct the reasonable costs from any amounts due or to become due Subcontractor in the next payment period.

3.14 SAFETY PROGRAMS Subcontractor is required to perform the Subcontract Work in a safe and reasonable manner. Subcontractor shall prevent against injury, loss, or damage to persons or property by taking reasonable steps to protect: (a) employees and other persons at the Worksite; (b) materials and

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equipment stored on or off the Worksite for performing the Subcontract Work; and (c) all property and structures located at the Worksite and adjacent.

3.14.1 Subcontractor shall give all required notices and comply with all applicable rules, regulations, orders, and other lawful requirements established to prevent injury, loss, or damage to persons or property.

3.14.2 Subcontractor shall implement appropriate safety programs pertaining to the Subcontract Work and the Project, including establishing safety rules, posting appropriate warnings and notices, erecting safety barriers, and establishing proper notice procedures to protect persons and property at the Worksite and adjacent to the Worksite from injury, loss, or damage.

3.14.3 Subcontractor shall exercise extreme care in carrying out any of the Subcontract Work which involves explosive or other dangerous methods of construction or hazardous procedures, materials, or equipment. Subcontractor shall use properly qualified individuals or entities to carry out the Subcontract Work in a safe and reasonable manner so as to reduce the risk of bodily injury or property damage.

3.14.4 Damage or loss not insured under property insurance and to the extent caused by the negligent or intentionally wrongful acts or omissions of Subcontractor, or anyone for whose acts Subcontractor may be liable, shall be promptly remedied by Subcontractor. Damage or loss to the extent caused by the negligent or intentionally wrongful acts or omissions of Constructor, or anyone for whose acts Constructor may be liable, shall be promptly remedied by Constructor.

3.14.5 Subcontractor is required to designate an individual at the Worksite in the employ of Subcontractor who shall act as Subcontractor's designated safety representative with a duty to prevent accidents. Unless otherwise identified by Subcontractor in writing to Constructor, the designated safety representative shall be Subcontractor's project superintendent. Such safety representative shall attend Worksite safety meetings as requested by Constructor.

3.14.6 Subcontractor has an affirmative duty not to overload the structures or conditions at the Worksite and shall take reasonable steps not to load any part of the structures or Worksite so as to give rise to an unsafe condition or create an unreasonable risk of bodily injury or property damage. Subcontractor shall have the right to request, in writing, from Constructor loading information concerning the structures at the Worksite.

3.14.7 Subcontractor shall give prompt written notice to Constructor of any accident involving bodily injury requiring a physician's care, any property damage exceeding five hundred dollars ($500.00) in value, or any failure that could have resulted in serious bodily injury, whether or not such an injury was sustained.

3.14.8 Prevention of accidents at the Worksite is the responsibility of Constructor, Subcontractor, and all other subcontractors, persons, and entities at the Worksite. Establishment of a safety program by Constructor shall not relieve Subcontractor or other parties of their safety responsibilities. Subcontractor shall establish its own safety program implementing safety measures, policies, and standards conforming to those required or recommended by governmental and quasi-governmental authorities having jurisdiction and by Constructor and Owner, including, but not limited to, requirements imposed by the Subcontract Documents. Subcontractor shall comply with the reasonable recommendations of insurance companies having an interest in the Project, and shall stop any part of the Subcontract Work which Constructor deems unsafe until corrective measures satisfactory to Constructor shall have been taken. Constructor's failure to stop Subcontractor's unsafe practices does not relieve Subcontractor of its responsibility. Subcontractor shall notify Constructor immediately following a reportable incident under applicable rules, regulations, orders,

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and other lawful requirements, and promptly confirm the notice in writing. A detailed written report shall be furnished if requested by Constructor. To the fullest extent permitted by Law, each Party to this Agreement shall indemnify the other Party from and against fines or penalties imposed as a result of safety violations, but only to the extent that such fines or penalties are caused by its failure to comply with applicable safety requirements. This indemnification obligation does not extend to additional or increased fines that result from repeated or willful violations not caused by Subcontractor's failure to comply with applicable rules, regulations, orders, and other lawful requirements.

3.14.9 Prior to the start of any work on the jobsite, Subcontractor shall furnish Constructor with an electronic copy of their Safety Manual and Silica Exposure Control Plan.

3.15 PROTECTION OF THE WORK Subcontractor shall take necessary precautions to properly protect the Subcontract Work and the work of others from damage caused by Subcontractor's operations. Should Subcontractor cause damage to the Subcontract Work or property of Owner, Constructor, or others, Subcontractor shall promptly remedy such damage to the satisfaction of Constructor, or Constructor may, after forty-eight (48) hours' written notice to Subcontractor, remedy the damage and deduct its cost from any amounts due or to become due Subcontractor, unless such costs are recovered under applicable property insurance.

3.16 EMERGENCIES In an emergency affecting the safety of persons or property, Subcontractor shall act to prevent threatened damage, injury, or loss. Any change in the Subcontract Amount or the Progress Schedule from actions of Subcontractor in an emergency situation shall be determined as provided in ARTICLE 7.

3.17 PERMITS AND TAXES Subcontractor shall give timely notices required by Law pertaining to the Subcontract Work, and is responsible for all permits, fees, licenses, assessments, inspections, testing, and taxes necessary to complete the Subcontract Work in accordance with the Subcontract Documents.

3.18 HAZARDOUS MATERIALS Subcontractor shall have the same rights and obligations as Constructor does under the Prime Agreement or Law regarding hazardous materials, provided that the hazardous materials affect the Subcontract Work's area or originate with Subcontractor.

3.19 SAFETY DATA SHEETS (SDS) Subcontractor shall submit to Constructor printed copies of all SDS required by law for materials or substances necessary for the performance of the Subcontract Work. SDS sheets obtained by Constructor from other subcontractors or sources shall be made available to Subcontractor by Constructor.

3.20 LAYOUT RESPONSIBILITY AND LEVELS Constructor shall establish principal axis lines of the building and Worksite, and benchmarks. Subcontractor shall lay out and be strictly responsible for the accuracy of the Subcontract Work and for any loss or damage to Constructor or others by reason of Subcontractor's failure to lay out or perform Subcontract Work correctly. Subcontractor shall exercise prudence so that the actual final conditions and details shall result in alignment of finish surfaces.

3.21 CORRECTION OF COVERED SUBCONTRACT WORK

3.21.1 UNCOVERING OF SUBCONTRACT WORK

3.21.1.1 If required in writing by Constructor, Subcontractor must uncover any portion of the Subcontract Work which has been covered by Subcontractor in violation of the Subcontract Documents or contrary to a directive issued to Subcontractor by Constructor. Upon receipt of a written directive from Constructor, Subcontractor shall uncover such work for Constructor's

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or Owner's inspection and restore the uncovered Subcontract Work to its original condition at Subcontractor's time and expense.

3.21.1.2 Constructor may direct Subcontractor to uncover portions of the Subcontract Work for inspection by Owner or Constructor at any time. Subcontractor is required to uncover such work whether or not Constructor or Owner had requested to inspect the Subcontract Work before such work was covered. Except as provided by the subsection immediately above, this Agreement shall be adjusted by Subcontract Change Order for the cost and time of uncovering and restoring any work which is uncovered for inspection and proves to be installed in accordance with the Subcontract Documents, provided Constructor had not previously instructed Subcontractor in writing to leave the work uncovered. If Subcontractor uncovers work pursuant to a directive issued by Constructor, and such work upon inspection does not comply with the Subcontract Documents, Subcontractor shall be responsible for all costs and time of uncovering, correcting, and restoring the work so as to make it conform to the Subcontract Documents. If Constructor or some other entity for which Subcontractor is not responsible caused the nonconforming condition, Constructor shall be required to adjust this Agreement by Subcontract Change Order for all such costs and time.

3.21.2 CORRECTION OF WORK

3.21.2.1 If the Design Professional or Constructor rejects the Subcontract Work or the Subcontract Work is not in conformance with the Subcontract Documents, Subcontractor shall promptly correct the Subcontract Work whether it had been fabricated, installed, or completed. Subcontractor shall be responsible for the costs of correcting such Subcontract Work, any additional testing, inspections, and compensation for services and expenses of Design Professional and Constructor made necessary by the defective Subcontract Work.

3.21.2.2 In addition to Subcontractor's obligations under this §3.21, Subcontractor agrees to promptly correct, after receipt of a written notice from Constructor, all Subcontract Work which proves to be defective in workmanship or materials within a period of one year from the date of substantial completion of the Subcontract Work or for a longer period of time as may be required by specific warranties in the Subcontract Documents. Substantial completion of the Subcontract Work, or of a designated portion, occurs on the date when construction is sufficiently complete in accordance with the Subcontract Documents so that Owner can occupy or utilize the Project, or a designated portion, for the use for which it is intended, without unapproved disruption. If, during the one-year period, Constructor fails to provide Subcontractor with prompt written notice of the discovery of defective or nonconforming Subcontract Work, Constructor shall neither have the right to require Subcontractor to correct such Subcontract Work nor the right to make a claim for breach of warranty. If Subcontractor fails to correct defective or nonconforming Subcontract Work within a reasonable time after receipt of notice from Constructor, Constructor may correct such Subcontract Work pursuant to §10.1.1.

3.21.3 Subcontractor's correction of Subcontract Work pursuant to this section shall not extend the one-year period for the correction of Subcontract Work, but if Subcontract Work is first performed after Substantial Completion, the one-year period for corrections shall commence when that Subcontract Work portion is substantially complete. Subcontractor's obligation to correct Subcontract Work within one year does not limit the enforcement of Subcontractor's other obligations with regard to the Agreement and the Subcontract Documents.

3.21.4 If Subcontractor's correction or removal of Subcontract Work destroys or damages other completed or partially completed work or existing buildings, Subcontractor shall be responsible for destroyed or damaged work correction costs.

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3.21.5 If portions of Subcontract Work which do not conform with the requirements of the Subcontract Documents are neither corrected by Subcontractor nor accepted by Constructor, Subcontractor shall remove such Subcontract Work from the Project Worksite if so directed by Constructor.

3.22 MATERIALS OR EQUIPMENT FURNISHED BY OTHERS If the scope of the Subcontract Work includes installation of materials or equipment furnished by others, Subcontractor is responsible for exercising proper care in receiving, handling, storing, and installing such items, unless otherwise provided in the Subcontract Documents. Subcontractor shall examine the items provided and report to Constructor in writing any items it may discover that do not conform to requirements of the Subcontract Documents. Subcontractor shall not proceed to install nonconforming items without further instructions from Constructor. Loss or damage due to acts or omissions of Subcontractor shall, upon two (2) Business Days' written notice to Subcontractor, be deducted from any amounts due or to become due Subcontractor.

3.23 SUBSTITUTIONS No substitutions shall be made in the Subcontract Work unless permitted in the Subcontract Documents, and only upon Subcontractor first receiving all approvals required under the Subcontract Documents for substitutions.

3.24 USE OF CONSTRUCTOR'S EQUIPMENT Subcontractor, its agents, employees, subcontractors, or suppliers shall use Constructor's equipment only with the express written permission of Constructor's designated representative and in accordance with Constructor's terms and conditions for such use. If Subcontractor or any of its agents, employees, subcontractors, or suppliers utilize any of Constructor's equipment, including machinery, tools, scaffolding, hoists, lifts, or similar items owned, leased, or under the control of Constructor, Subcontractor shall indemnify and be liable to Constructor as provided in ARTICLE 9 for any loss or damage (including bodily injury or death) which may arise from such use, except to the extent that such loss or damage is caused by the negligence of Constructor's employees operating Constructor's equipment.

3.25 WORK FOR OTHERS Until final completion of the Subcontract Work, Subcontractor agrees not to perform any work directly for Owner or any tenants, or deal directly with Owner's representatives in connection with the Subcontract Work, unless otherwise approved in writing by Constructor.

3.26 SYSTEMS AND EQUIPMENT STARTUP With the assistance of Owner's maintenance personnel and Constructor, Subcontractor shall direct the check-out and operation of systems and equipment for readiness, and assist in their initial startup and the testing of the Subcontract Work.

3.27 COMPLIANCE WITH LAWS Subcontractor agrees to comply with the Law at its own cost. Subcontractor shall be liable to Constructor and Owner for all loss, cost, and expense attributable to any acts or omissions by Subcontractor, its employees, subcontractors, suppliers, and agents resulting from the failure to comply with the Law, including any fines, penalties, or corrective measures, except as provided in §3.14.8. However, liability under this section shall not apply if prior approval by appropriate authorities and Constructor is received.

3.27.1 To the extent Constructor receives reimbursement or additional time from Owner under the Prime Agreement, the Subcontract Amount or Progress Schedule shall be equitably adjusted for changes in the Law enacted after the date of this Agreement, including taxes, affecting the performance of the Work.

3.28 CONFIDENTIALITY To the extent the Prime Agreement provides for the confidentiality of any of Owner's proprietary or otherwise confidential information disclosed in connection with the performance of this Agreement, Subcontractor is equally bound by Owner's confidentiality requirements.

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3.29 ROYALTIES, PATENTS, AND COPYRIGHTS Subcontractor shall pay all royalties and license fees which may be due on the inclusion of any patented or copyrighted materials, methods, or systems selected by Subcontractor and incorporated in the Subcontract Work. Subcontractor shall defend, indemnify, and hold Constructor and Owner harmless from all suits or claims for infringement of any patent rights or copyrights arising out of such selection. Subcontractor shall be liable for all loss, including all costs, expenses, and attorneys' fees, but shall not be responsible for such defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Subcontract Documents. However, if Subcontractor has reason to believe a particular design, process, or product required by Subcontract Documents is an infringement of a patent, Subcontractor shall promptly furnish such information to Constructor or be responsible to Constructor and Owner for any loss as a result.

ARTICLE 4 CONSTRUCTOR'S RESPONSIBILITIES

4.1 CONSTRUCTOR'S REPRESENTATIVE Constructor's authorized representative is Chad Everts. Constructor's representative shall be the only person Subcontractor shall look to for instructions, orders, or directions, except in an emergency. If Constructor changes its representative, Constructor shall promptly notify Subcontractor in writing.

4.2 OWNER'S ABILITY TO PAY

4.2.1 Unless expressly prohibited by the Prime Agreement, Constructor shall promptly provide to Subcontractor the following information received from Owner: (a) upon Subcontractor's request, information regarding Owner's financial ability to pay for the Work, and (b) notice of any material variation in Owner's financial ability to pay. Constructor, however, does not warrant the accuracy or completeness of the information provided.

4.2.2 If Subcontractor does not receive the information referenced in the subsection immediately above with regard to Owner's ability to pay for the Work as required by the Contract Documents, Subcontractor may request the information from Owner or Owner's lender.

4.3 CONSTRUCTOR APPLICATION FOR PAYMENT Upon request, Constructor shall give Subcontractor a copy of the most current Constructor application for payment reflecting the amounts approved or paid by Owner for the Subcontract Work performed to date.

4.4 INFORMATION OR SERVICES Subcontractor is entitled to request through Constructor any information or services required for Subcontractor's performance of the Subcontract Work which is under Owner's control. Subcontractor also is entitled to request through Constructor any information necessary to give notice of or enforce mechanic's lien rights and, where applicable, stop notices. This information shall include Owner's interest in the real property on which the Project is located and the recorded legal title. To the extent Constructor receives such information or services, Constructor shall provide them to Subcontractor in a timely manner. Constructor, however, does not warrant the accuracy or completeness of the information provided by Owner. To the extent Owner provides any warranty of Owner provided information, Constructor agrees to permit Subcontractor to prosecute a claim in the name of Constructor for the use and benefit of Subcontractor, pursuant to §5.3.2.

4.5 STORAGE AREAS Constructor shall allocate adequate storage areas, if available, for Subcontractor's materials and equipment during the course of the Subcontract Work. Unless otherwise agreed upon, Constructor shall reimburse Subcontractor for the additional costs of having to relocate such storage areas at the direction of Constructor.

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4.6 TIMELY COMMUNICATIONS Constructor shall transmit to Subcontractor, with reasonable promptness, all submittals, transmittals, and written approvals relative to the Subcontract Work. Unless otherwise specified in the Subcontract Documents, if communications are not through Subcontractor, Constructor shall inform Subcontractor of the communications Constructor has with Subcontractor's subcontractors and suppliers.

4.7 USE OF SUBCONTRACTOR'S EQUIPMENT Constructor, its agents, employees, other subcontractors, or suppliers shall use Subcontractor's equipment only with the express written permission of Subcontractor's designated representative and in accordance with Subcontractor's terms and conditions for such use. If Constructor or any of its agents, employees, or suppliers utilize any of Subcontractor's equipment, including machinery, tools, scaffolding, hoists, lifts, or similar items owned, leased, or under the control of Subcontractor, Constructor shall indemnify and hold harmless Subcontractor as provided in ARTICLE 9 for any loss or damage which may arise from such use, except to the extent that such loss or damage is caused by the negligence of Subcontractor's employees operating Subcontractor's equipment.

ARTICLE 5 PROGRESS SCHEDULE

5.1 TIME IS OF THE ESSENCE Time is of the essence with regard to the obligations of the Subcontract Documents.

5.2 SCHEDULE Subcontractor shall provide Constructor with any scheduling information proposed by Subcontractor for the Subcontract Work. In consultation with Subcontractor, Constructor shall prepare the schedule for performance of the Work ("Progress Schedule") and shall revise and update such schedule, as necessary, as the Work progresses. The Progress Schedule binds each Party and all subsequent changes and additional details shall be submitted to Subcontractor promptly and reasonably in advance of the required performance. Constructor shall have the right to determine and, if necessary, make reasonable changes to the time, order, and priority in which the various portions of the Work shall be performed and all other matters relative to the Subcontract Work. To the extent such changes increase Subcontractor's time and costs, Subcontractor may seek equitable adjustment in the Subcontract Amount or Subcontract Time in accordance with the Subcontract Documents.

5.3 DELAYS AND EXTENSIONS OF TIME

5.3.1 OWNER CAUSED DELAY Subject to §5.3.2, if the commencement or progress of the Subcontract Work is delayed without the fault or responsibility of Subcontractor, the Subcontract Time shall be extended by Subcontract Change Order and the Subcontract Amount equitably adjusted to the extent obtained by Constructor under the Subcontract Documents, and the Progress Schedule shall be revised accordingly.

5.3.2 CLAIMS RELATING TO OWNER Subcontractor agrees to initiate all claims for which Owner is or may be liable in the manner and within the time limits provided in the Subcontract Documents for like claims by Constructor upon Owner and in sufficient time for Constructor to initiate such claims against Owner in accordance with the Subcontract Documents. At Subcontractor's request and expense to the extent agreed upon in writing, Constructor agrees to permit Subcontractor to prosecute a claim in the name of Constructor for the use and benefit of Subcontractor in the manner provided in the Subcontract Documents for like claims by Constructor upon Owner.

5.3.3 CONSTRUCTOR CAUSED DELAY Nothing in this article precludes Subcontractor's recovery of delay damages caused by Constructor.

5.3.4 CLAIMS RELATING TO CONSTRUCTOR Subcontractor shall give Constructor written notice of all claims not included in §5.3.2 within fourteen (14) Days of Subcontractor's knowledge of the facts

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giving rise to the claim. Thereafter, Subcontractor shall submit written documentation of its claim, including appropriate supporting documentation, within twenty-one (21) Days after giving notice, unless the Parties agree upon a longer period of time. Constructor shall respond in writing denying or approving, in whole or in part, Subcontractor's claim no later than fourteen (14) Days after receipt of Subcontractor's documentation of claim. Constructor's failure to respond shall be deemed a denial of Subcontractor's claim. All unresolved claims, disputes, and other matters in question between the Parties not relating to claims included in §5.3.2 shall be resolved as provided for in ARTICLE 11.

5.4 LIMITED MUTUAL WAIVER OF CONSEQUENTIAL DAMAGES

5.4.1 Except for any (a) liquidated, consequential, or other damages that Owner is entitled to recover against Constructor under the Prime Agreement, and (b) losses covered by insurance required by the Subcontract Documents, the Parties mutually waive all claims against each other for consequential damages, including but not limited to, damages for loss of business, loss of financing, loss of profits not related to this Project, loss of bonding capacity, loss of reputation, or insolvency. Similarly, Subcontractor shall obtain in contracts with its subcontractors mutual waivers of consequential damages that correspond to Subcontractor's waiver of consequential damages. The provisions of this subsection shall also apply to and survive this Agreement.

5.5 Not Used

ARTICLE 6 SUBCONTRACT AMOUNT

6.1 As full compensation for performance of this Agreement, Constructor agrees to pay Subcontractor in current funds for the satisfactory performance of the Subcontract Work subject to all applicable provisions of this Agreement:

6.1.1 the fixed-price of [_____] dollars ($[_____]) subject to additions and deductions as provided for in the Subcontract Documents; or

6.1.2 alternates and unit prices in accordance with the attached schedule of alternates and unit prices and estimated quantities, which is incorporated by reference and identified as Exhibit D; or

6.1.3 time and material rates and prices in accordance with the attached Schedule of Labor and Material Costs which is incorporated by reference and identified as Exhibit [_____].

The fixed-price, unit prices, or time and material rates and prices are referred to as the Subcontract Amount.

ARTICLE 7 CHANGES

7.1 Subcontractor may request or Constructor may order changes in the Subcontract Work or the timing or sequencing of the Subcontract Work that impacts the Subcontract Amount or Subcontract Time. A change in the Subcontract Work that affects the Subcontract Amount or the Subcontract Time shall be formalized in a Subcontract Change Order and processed in accordance with this article.

7.1.1 For changes in the Subcontract Work, the Parties shall negotiate in good faith an appropriate adjustment to the Subcontract Amount or the Subcontract Time and shall conclude these negotiations as expeditiously as possible. Acceptance of the Subcontract Change Order and any adjustment in the Subcontract Amount or Subcontract Time shall not be unreasonably withheld.

7.2 Not Used

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7.3 CONCEALED OR UNKNOWN SITE CONDITIONS If a condition encountered at the Worksite is (a) a subsurface or other physical condition materially different from those indicated in the Subcontract Documents, or (b) an unusual and unknown physical condition materially different from conditions ordinarily encountered and generally recognized as inherent in the Subcontract Work provided for in the Subcontract Documents, Subcontractor shall stop affected Work after the condition is first observed and give prompt written notice of the condition to Constructor. Subcontractor shall not be required to perform any Work relating to the condition without the written mutual agreement of the Parties. Any change in the Contract Price or the Contract Time as a result of the condition, including a dispute about its existence or nature, shall be determined as provided in ARTICLE 7.

7.4 ADJUSTMENTS IN SUBCONTRACT AMOUNT An adjustment in the Subcontract Amount resulting from a Subcontract Change Order shall be determined by one of the following methods:

7.4.1 mutual acceptance of an itemized lump sum;

7.4.2 unit prices as indicated in the Subcontract Documents or as subsequently agreed to by the Parties; or

7.4.3 costs as determined in the Subcontract Documents or in a manner otherwise acceptable to the Parties, and a mutually acceptable fixed or percentage fee.

7.5 SUBSTANTIATION OF ADJUSTMENT If Subcontractor does not respond promptly or disputes the method of adjustment, the method and the adjustment shall be determined by Constructor on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in the case of an increase in the Subcontract Amount, an allowance for overhead and profit of the percentage provided in §7.6, or if none is provided, as mutually agreed upon by the Parties. Subcontractor may contest the reasonableness of any adjustment determined by Constructor. Subcontractor shall maintain for Constructor's review and approval an appropriately itemized and substantiated accounting of the following items attributable to the Subcontract Change Order:

7.5.1 labor costs, including Social Security, health, welfare, retirement, and other fringe benefits as normally required, and state workers' compensation insurance;

7.5.2 costs of materials, supplies, and equipment, whether incorporated in the Subcontract Work or consumed, including transportation costs;

7.5.3 costs of renting machinery and equipment other than hand tools;

7.5.4 costs of bond and insurance premiums, permit fees, and taxes attributable to the change; and

7.5.5 costs of additional supervision and field office personnel services necessitated by the change.

7.6 Adjustments shall be based on net change in Subcontractor's reasonable cost of performing the changed Subcontract Work plus, in case of a net increase in cost, an agreed upon sum for overhead and profit not to exceed ten percent (4%).

7.7 NO OBLIGATION TO PERFORM Subcontractor shall not be obligated to perform changes in the Subcontract Work until a Subcontract Change Order has been executed or written instructions have been issued in accordance with §7.8.

7.8 INCIDENTAL CHANGES Constructor may direct Subcontractor to perform incidental changes in the Subcontract Work which do not involve adjustments in the Subcontract Amount or the Subcontract Time. Incidental changes shall be consistent with the scope and intent of the Subcontract Documents.

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ARTICLE 8 PAYMENT

8.1 SCHEDULE OF VALUES As a condition precedent to payment, Subcontractor shall provide a schedule of values satisfactory to Constructor not more than fifteen (15) Days from the date of execution of this Agreement.

8.2 PROGRESS PAYMENTS

8.2.1 APPLICATIONS Subcontractor's applications for payment shall be itemized and supported by substantiating data as required by the Subcontract Documents. If Subcontractor is obligated to provide design services pursuant to §3.8, Subcontractor's applications for payment shall show its design professional's fee and expenses as a separate cost item. Subcontractor's application for payment shall be notarized. Subcontractor's application for payment for the Subcontract Work performed in the preceding payment period shall be submitted for approval by Constructor in accordance with the schedule of values if required in §8.2.2 through §8.2.4. Constructor shall incorporate the approved amount of Subcontractor's application for payment into Constructor's application for payment to Owner for the same period and submit it to Owner in a timely fashion. Constructor shall promptly notify Subcontractor of any changes in the amount requested on behalf of Subcontractor.

8.2.2 RETAINAGE The rate of retainage shall be ten percent (10%).

8.2.3 TIME OF APPLICATION Subcontractor shall submit progress payment applications to Constructor no later than the 24th Day of each payment period for the Subcontract Work performed up to and including the 20th Day of the payment period indicating work completed and, to the extent allowed under the subsection below, materials suitably stored during the preceding payment period.

8.2.4 STORED MATERIALS Unless otherwise provided in the Subcontract Documents, applications for payment may include materials and equipment not yet incorporated in the Subcontract Work but delivered to and suitably stored on or off the Worksite including applicable insurance, storage, and costs incurred transporting the materials to an off-site storage facility. Approval of payment applications for such stored items on or off the Worksite shall be conditioned upon submission by Subcontractor of bills of sale and required insurance or such other procedures satisfactory to Owner and Constructor to establish Owner's title to such materials and equipment, or otherwise to protect Owner's and Constructor's interest including transportation to the Worksite.

8.2.5 TIME OF PAYMENT Progress payments to Subcontractor for satisfactory performance of the Subcontract Work shall be made no later than seven (7) Days after receipt by Constructor of payment from Owner for the Subcontract Work. If payment from Owner for such Subcontract Work is not received by Constructor, through no fault of Subcontractor, Constructor will make payment to Subcontractor within a reasonable time for the Subcontract Work satisfactorily performed.

8.2.6 PAYMENT DELAY If Constructor has received payment from Owner and if for any reason not the fault of Subcontractor, Subcontractor does not receive a progress payment from Constructor within seven (7) Days after the date such payment is due, as defined in the subsection immediately above, or, if Constructor has failed to pay Subcontractor within a reasonable time for the Subcontract Work satisfactorily performed, Subcontractor, upon giving seven (7) Days' written notice to Constructor, and without prejudice to and in addition to any other legal remedies, may stop work until payment of the full amount owing to Subcontractor has been received. The Subcontract Amount and Time shall be adjusted by the amount of Subcontractor's reasonable and verified cost of shutdown, delay, and startup, which shall be effected by an appropriate Subcontractor Change Order.

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8.2.7 PAYMENTS WITHHELD Constructor may reject a Subcontractor application for payment in whole or in part or withhold amounts from a previously approved Subcontractor application for payment, as may reasonably be necessary to protect Constructor from loss or damage for which Constructor may be liable and without incurring an obligation for late payment interest based upon:

8.2.7.1 Subcontractor's repeated failure to perform the Subcontract Work as required by this Agreement;

8.2.7.2 except as accepted by the insurer providing Builder's Risk or other property insurance covering the Project, loss or damage arising out of or relating to this Agreement and caused by Subcontractor to Owner, Constructor, or others to whom Constructor may be liable;

8.2.7.3 Subcontractor's failure to properly pay for either labor, materials, equipment, or supplies furnished in connection with the Subcontract Work, provided that Constructor is making payments to Subcontractor for that portion of the Subcontract Work in accordance with this Agreement;

8.2.7.4 rejected or defective Subcontract Work which has not been corrected in a timely fashion;

8.2.7.5 reasonable evidence of delay in performance of the Subcontract Work such that the Work will not be completed within the Subcontract Time, and that the unpaid balance of the Subcontract Amount is not sufficient to offset the liquidated damages or actual damages that may be sustained by Constructor as a result of the anticipated delay caused by Subcontractor;

8.2.7.6 reasonable evidence demonstrating that the unpaid balance of the Subcontract Amount is insufficient to cover the cost to complete the Subcontract Work; and

8.2.7.7 uninsured third-party claims involving Subcontractor or reasonable evidence demonstrating that third-party claims are likely to be filed unless and until Subcontractor furnishes Constructor with adequate security in the form of a surety bond, letter of credit, or other collateral or commitment sufficient to discharge such claims if established.

No later than seven (7) Days after receipt of an application for payment, Constructor shall give written notice to Subcontractor, at the time of disapproving or nullifying all or part of an application for payment, stating its specific reasons for such disapproval or nullification, and the remedial actions to be taken by Subcontractor in order to receive payment. When the above reasons for disapproving or nullifying an application for payment are removed, payment will be promptly made for the amount previously withheld.

8.2.8 SUBSTANTIAL COMPLETION

8.2.8.1 Upon substantial completion of the Subcontract Work or a designated portion thereof, Constructor shall assume responsibility for security and protection of the Subcontract Work pending the achievement of Substantial Completion of the Project. However, acceptance of the Subcontract Work for the purpose of allowing succeeding Work to proceed shall not result in the commencement of the warranty period for the Subcontract Work unless otherwise provided in the Prime Agreement.

8.2.8.2 Unless otherwise provided for in the Prime Agreement, partial Owner occupancy or use of completed portions of the Subcontract Work shall constitute Substantial Completion of that portion of the Subcontract Work and the warranty period applicable to the Subcontract

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Work shall commence upon the achievement of Substantial Completion of the Project and acceptance by Owner under the terms of the Prime Agreement.

8.3 FINAL PAYMENT

8.3.1 APPLICATION Upon acceptance of the Subcontract Work by Owner and Constructor and receipt from Subcontractor of evidence of fulfillment of Subcontractor's obligations in accordance with the Subcontract Documents and the subsection below, Constructor shall incorporate Subcontractor's application for final payment into Constructor's next application for payment to Owner without delay, or notify Subcontractor if there is a delay and the reasons for the delay.

8.3.2 REQUIREMENTS Before Constructor shall be required to incorporate Subcontractor's application for final payment into Constructor's next application for payment, Subcontractor shall submit to Constructor:

(a) An affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Subcontract Work have been paid, satisfied, or are to be paid with the proceeds of final payment, so as not to encumber Owner's property, Constructor, or Constructor's surety;

(b) As-built drawings, manuals, copies of warranties, startup and testing required in §3.26, and all close-out documents and satisfaction of close-out procedures if required by the Subcontract Documents.

(c) Release of any liens, conditioned on final payment being received, and in such form as may be required by the Subcontract Documents;

(d) Consent of surety to final payment, if required;

(e) A report of any outstanding known and unreported accidents or injuries experienced by Subcontractor at the Worksite;

(f) Other data, if required, such as receipts and releases.

8.3.3 TIME OF PAYMENT Final payment of the balance due of the Subcontract Amount shall be made to Subcontractor within seven (7) Days after receipt by Constructor of final payment from Owner for such Subcontract Work.

8.3.4 FINAL PAYMENT DELAY If Owner or its designated agent does not issue a certificate for final payment or Constructor does not receive such payment for any cause which is not the fault of Subcontractor, Constructor shall promptly inform Subcontractor in writing. If final payment from Owner for such Subcontract Work is not received by Constructor, through no fault of Subcontractor, Constructor will make payment to Subcontractor within a reasonable time.

8.3.5 WAIVER OF CLAIMS Final payment shall constitute a waiver of all claims by Subcontractor relating to the Subcontract Work, but shall in no way relieve Subcontractor of liability for the obligations assumed under §3.20 and §3.21, or for faulty or defective work or services discovered after final payment, nor relieve Constructor for claims made in writing by Subcontractor as required by the Subcontract Documents before its application for final payment as unsettled at the time of such payment.

8.4 LATE PAYMENT INTEREST Progress payments or final payment due and unpaid under this Agreement shall bear interest from the date payment is due at the prevailing statutory rate at the place of

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the Project. However, if Owner fails to timely pay Constructor through no fault or neglect of Constructor, and Constructor fails to timely pay Subcontractor as a result of such nonpayment, Constructor's obligation to pay Subcontractor interest on corresponding payments due and unpaid under this Agreement shall be extinguished by Constructor promptly paying to Subcontractor Subcontractor's proportionate share of the interest, if any, received by Constructor from Owner on such late payments.

8.5 CONTINUING OBLIGATIONS Provided Constructor is making payments in accordance with this Agreement, Subcontractor shall reimburse Constructor for costs and expenses for any claim, obligation, or lien asserted before or after final payment is made that arises from the performance of the Subcontract Work. Subcontractor shall reimburse Constructor for costs and expenses including attorneys' fees and costs and expenses incurred by Constructor in satisfying, discharging, or defending against any such claims, obligation, or lien, including any action brought or judgment recovered. If any Law or bond requires Subcontractor to take any action before the expiration of the reasonable time for payment referenced in §8.2.5 in order to preserve or protect Subcontractor's rights with respect to mechanic's lien or bond claims, then Subcontractor may take that action before the expiration of the reasonable time for payment and such action will not: (a) create the reimbursement obligation recited above, (b) be in violation of this Agreement, or (c) be considered premature for purposes of preserving and protecting Subcontractor's rights.

8.6 PAYMENT USE RESTRICTION Payments received by Subcontractor shall be used to satisfy the indebtedness owed by Subcontractor to any person furnishing labor or materials, or both, for use in performing the Subcontract Work through the most current period applicable to progress payments received from Constructor before it is used for any other purpose. In the same manner, payments received by Constructor for the Subcontract Work shall be dedicated to payment to Subcontractor. This applies to this Agreement only, and is not for the benefit of third parties. Moreover, this section does not restrict commingling funds nor require separate accounts for deposits. Nothing in this section creates a fiduciary duty on the Parties, nor creates any tort cause of action or liability for breach of trust, punitive damages, or other equitable remedy or liability for alleged breach.

8.7 PAYMENT VERIFICATION If Constructor has reason to believe that Subcontractor is not complying with payment terms in this Agreement, Constructor may contact Subcontractor's subcontractors and suppliers to ascertain whether they are being paid by Subcontractor in accordance with this Agreement.

8.8 PARTIAL LIEN WAIVERS AND AFFIDAVITS As a prerequisite for payments, Subcontractor shall provide, in a form satisfactory to Owner and Constructor, partial lien and claim waivers in the amount of the application for payment and affidavits (sworn statement) covering its subcontractors and suppliers for completed Subcontract Work. Such waivers shall be conditional upon payment. In no event shall Subcontractor be required to provide an unconditional waiver of lien or claim, before receiving payment or in an amount in excess of what it has been paid.

8.9 SUBCONTRACTOR PAYMENT FAILURE Upon payment by Constructor, Subcontractor shall promptly pay its subcontractors and suppliers the amounts to which they are entitled. If Constructor has reason to believe that labor, material, or other obligations incurred in the performance of the Subcontract Work are not being paid, Constructor may give written notice of a potential claim or lien to Subcontractor and may take any steps deemed necessary to assure that progress payments are utilized to pay such obligations, including but not limited to the issuance of joint checks. If upon receipt of notice, Subcontractor does not (a) supply evidence to the satisfaction of Constructor that payment owed has been paid; or (b) post a bond indemnifying Owner, Constructor, Constructor's surety, if any, and the premises from a claim or lien, Constructor shall have the right to withhold from any payments due or to become due to Subcontractor a reasonable amount to protect Constructor from any and all loss, damage, or expense including attorneys' fees that may arise out of or relate to any such claim or lien.

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8.10 SUBCONTRACTOR ASSIGNMENT OF PAYMENTS Subcontractor shall not assign any payment due or to become due under this Agreement, without the written consent of Constructor, unless the assignment is intended to create a new security interest within the scope of Article 9 of the Uniform Commercial Code. Should Subcontractor assign all or any part of any payment due or to become due under this Agreement to create a new security interest or for any other purpose, the instrument of assignment shall contain a clause to the effect that the assignee's right in and to any money due or to become due to Subcontractor shall be subject to the claims of all persons, firms, and corporations for services rendered or materials supplied for Subcontract Work.

8.11 PAYMENT NOT ACCEPTANCE Payment to Subcontractor does not constitute or imply acceptance of any portion of the Subcontract Work.

ARTICLE 9 INDEMNITY, INSURANCE, AND BONDS

9.1 INDEMNITY

9.1.1 INDEMNITY To the fullest extent permitted by law, Subcontractor shall indemnify and hold harmless Constructor, Design Professional, Owner, and their agents, consultants, and employees (the "Indemnitees") from all claims for bodily injury and property damage other than to the Work itself that may arise from the performance of the Subcontract Work, including reasonable attorneys' fees, costs, and expenses, that arise from the performance of the Work, but only to the extent caused by the negligent or intentionally wrongful acts or omissions of Subcontractor, Subcontractor's subcontractors, or anyone employed directly or indirectly by any of them or by anyone for whose acts any of them may be liable.

9.1.2 NO LIMITATION ON LIABILITY In any claim against the Indemnitees by any employee of Subcontractor, anyone directly or indirectly employed by Subcontractor, or anyone for whose acts Subcontractor may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

9.2 INSURANCE

9.2.1 SUBCONTRACTOR'S INSURANCE Before commencing the Subcontract Work, and as a condition precedent to payment, Subcontractor shall purchase and maintain insurance that will protect it from the claims arising out of its operations under this Agreement, whether the operations are by Subcontractor, or any of its consultants or subcontractors or anyone directly or indirectly employed by any of them for whose acts Subcontractor may be liable.

9.2.2 MINIMUM LIMITS OF LIABILITY Subcontractor shall procure and maintain in force Workers' Compensation Insurance, Employers' Liability Insurance, Business Automobile Liability Insurance, and Commercial General Liability Insurance (CGL) with insurance companies licensed in the jurisdiction in which the Project is located and acceptable to Constructor, which acceptance shall not be unreasonably withheld, at least the limits of liability as set forth below.

9.2.2.1 Worker's Compensation and Employers Liability Insurance in accordance with the laws of the State of Michigan.

9.2.2.2 Commercial General Liability Insurance
a. Each Occurrence Limit $1,000,000
b. General Aggregate $2,000,000

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c. Products/Completed Operations Aggregate $2,000,000
d. Personal and Advertising Injury Limit $1,000,000

9.2.2.3 Comprehensive Automobile Liability Insurance
Combined Single Limit Bodily Injury and Property Damage $1,000,000 Each Occurrence

9.2.2.4 ADDITIONAL INSUREDS Policies under 9.2.2.2 and 9.2.2.3 shall list Fishbeck and the Owner as additional insureds, as well as other parties if required by the Contract Documents.

9.2.3 PROFESSIONAL LIABILITY INSURANCE

9.2.3.1 If required by §3.8, Subcontractor shall require its design professional(s) to maintain professional liability insurance with a company reasonably satisfactory to Constructor, including contractual liability insurance against the liability assumed, and including coverage for any professional liability caused by consultants of its design professional. Said insurance shall have specific minimum limits as set forth below:

Limit of Two Million dollars ($2,000,000) per claim.

General Aggregate of Two Million dollars ($2,000,000) for the subcontract services rendered.

The professional liability insurance shall contain prior acts coverage sufficient to cover all subcontract services rendered by the design professional. Said insurance shall be continued in effect with an extended period of Two years following final payment to the design professional. Such insurance shall have a maximum self-insured retention and/or deductible in the amount of One Hundred Fifty Thousand dollars ($150,000) per claim. The self-insured retention and/or deductible shall be paid by the Subcontractor or its design professional.

9.2.3.2 Subcontractor shall require its design professional to furnish to Subcontractor and Constructor, before the design professional commences its services, a copy of its professional liability policy evidencing the coverages required in this subsection. No policy shall be canceled or modified, with the exception of non-payment, without thirty (30) Days' prior written notice to Subcontractor and Constructor.

9.2.4 NUMBER OF POLICIES Commercial General Liability Insurance (CGL) and other liability insurance may be arranged under a single policy for the full limits required or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability Policy.

9.2.5 CANCELLATION, RENEWAL, AND MODIFICATION To the extent commercially available to Subcontractor from its current insurance company, insurance policies required under §9.2.1 shall contain a provision that the insurance company or its designee must give Constructor written notice transmitted in paper or electronic format: (a) 30 Days before coverage is nonrenewed by the insurance company and (b) within 10 Business Days after cancellation, for reasons other than non-payment, of coverage by the insurance company. Before commencing the Work and upon renewal or replacement of the insurance policies, Subcontractor shall furnish Constructor with certificates of insurance until one year after Substantial Completion or longer if required by the Contract Documents. In addition, if any insurance policy required under §9.2.1 is not to be immediately replaced without lapse in coverage when it expires, exhausts its limits, or is to be canceled, Subcontractor shall give Constructor prompt written notice upon actual or constructive knowledge of such condition. Subcontractor will be in breach of contract if the Constructor does not receive prior notification of any cancellation, non-renewal, or modification of the required policy coverage or limits.

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9.2.6 CONTINUATION OF COVERAGE Subcontractor shall continue to carry Completed Operations Liability Insurance for at least one year after final payment to Constructor. Before commencing the Work, Subcontractor shall furnish Constructor with certificates evidencing the required coverages.

9.2.7 BUILDER'S RISK POLICY INSURANCE Upon Subcontractor's written request, Constructor shall provide Subcontractor with a copy of the Builder's Risk policy of insurance or any other property or equipment insurance in force for the Project and procured by Owner or Constructor. Constructor shall advise Subcontractor if a Builder's Risk policy of insurance is not in force.

9.2.8 WAIVER OF SUBROGATION The Parties waive all rights against each other, Owner, and Design Professional, and any of their respective consultants, subcontractors, subsubcontractors, suppliers, agents, and employees, for damages caused by perils to the extent covered by the proceeds of the insurance provided in §9.2.7, except such rights as they may have to the insurance proceeds and such rights as they may have for the failure to obtain and maintain any Project Builders Risk Coverage that they may have been obligated to provide in the Prime Agreement. Subcontractor shall require similar waivers from its subcontractors. The policies under clauses 9.2.2, 9.2.3, and 9.2.7 shall also be endorsed to state that the carrier waives any right against the Owner, Constructor, Design Professional, Subcontractors, material Suppliers, or Subsubcontractors.

9.2.9 ENDORSEMENT If the policies of insurance referred to in this article require an endorsement to provide for continued coverage where there is a waiver of subrogation, the owners of such policies will cause them to be so endorsed.

9.2.10 ADDITIONAL GENERAL LIABILITY COVERAGE Constructor shall require Subcontractor to purchase and maintain additional liability coverage, primary to Constructor's coverage pursuant to the subsection immediately above. If required, the additional liability coverage required of Subcontractor shall be:

9.2.10.1 ADDITIONAL INSURED. Constructor and Owner shall be named as an additional insured on Subcontractor's CGL specified, for on-going operations and completed operations, excess/umbrella liability, commercial automobile liability, and any required pollution liability, but only with respect to liability for bodily injury, property damage, or personal and advertising injury to the extent caused by the negligent acts or omissions of Subcontractor, or those acting on Subcontractor's behalf, in the performance of Subcontract Work for Constructor at the Worksite. The insurance of the Subcontractor shall be primary and non-contributory to any insurance available to the Additional Insureds.

9.3 BONDS

9.3.1 Performance and Payment Bonds are required of Subcontractor for any contract over $100,000. Such bonds shall be issued by a surety admitted in the state in which the Project is located and must be acceptable to Constructor. Constructor's acceptance shall not be withheld without reasonable cause. The penal sum of the Payment Bond and Performance Bond shall each be in the original full Subcontract Amount.

9.3.2 Subcontractor shall be reimbursed, without retainage, for the cost of any required performance or payment bonds simultaneously with the first progress payment. The reimbursement amount for Subcontractor bonds shall be one hundred percent (100%) of the Subcontract Amount, which sum is included in the Subcontract Amount. If acceptable to Constructor, Subcontractor may, in lieu of retainage, furnish a retention bond or other security interest, acceptable to Constructor, to be held by Constructor.

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9.3.3 If Subcontractor shall fail to promptly provide any required bonds, Constructor may terminate this Agreement and enter into a subcontract for the balance of the Subcontract Work with another subcontractor. All Constructor costs and expenses incurred by Constructor as a result of said termination shall be paid by Subcontractor.

9.3.4 PAYMENT BOND REVIEW Constructor ☐ has/ ☐ has not provided Owner a payment bond.

ARTICLE 10 SUSPENSION, NOTICE TO CURE, AND TERMINATION

10.1 FAILURE OF PERFORMANCE AND TERMINATION

10.1.1 NOTICE TO CURE A DEFAULT If Subcontractor persistently fails to supply enough qualified workers, proper materials, or equipment to maintain the Progress Schedule, or fails to make prompt payment to its workers, subsubcontractors, or suppliers, or disregards a Law or orders of any public authority having jurisdiction, or otherwise is guilty of a material breach of a provision of this Agreement, Subcontractor shall be deemed in default of this Agreement. If Subcontractor fails within three (3) Business Days after written notification to commence and continue satisfactory correction of the default with diligence and promptness, then Constructor shall give a second notice to Subcontractor and surety, if any, to correct the default within a two (2) Business Day period. If Subcontractor fails to promptly commence and continue satisfactory correction of the default following receipt of such second notice, Constructor without prejudice to any other rights or remedies, shall have the right to any or all of the following remedies:

10.1.1.1 supply workers, materials, equipment, and facilities as Constructor deems necessary for the completion of the Subcontract Work or any part which Subcontractor has failed to complete or perform after written notification, and charge Subcontractor costs and expenses, including reasonable overhead, profit, and attorneys' fees that are due or to become due. Subcontractor shall be liable for the payment of any amount by which such expense may exceed the unpaid balance of the Subcontract Amount. At Subcontractor's request, Constructor shall provide a detailed accounting of the costs to finish the Subcontract Work;

10.1.1.2 contract with one or more additional contractors to perform such part of the Subcontract Work as Constructor determines will provide the most expeditious completion of the Work, and charge the cost to Subcontractor as provided under the subsection above;

10.1.1.3 withhold any payments due or to become due Subcontractor pending corrective action in amounts sufficient to cover losses and compel performance to the extent required by and to the satisfaction of Constructor. In the event of an emergency affecting the safety of persons or property, Constructor may proceed as above without notice, but Constructor shall give Subcontractor notice promptly after the fact as a precondition of cost recovery; or

10.1.1.4 terminate the Agreement by written notice.

10.1.2 USE OF SUBCONTRACTOR'S EQUIPMENT If Constructor performs work under this article, either directly or through other subcontractors, Constructor or other subcontractors shall have the right to take and use any materials or supplies for which Constructor or other subcontractors have paid and located at the Worksite for the purpose of completing any remaining Subcontract Work. Constructor shall also have the right to use construction tools and equipment located on the Worksite and belonging to the Subcontractor and its subcontractors for the purpose of completing the remaining Work, which shall not be unreasonably withheld. If Constructor uses the tools and equipment in accordance with this subsection, Constructor shall indemnify and hold harmless Subcontractor in connection with Constructor's use of such tools and equipment. Immediately upon completion of the Subcontract Work, any remaining materials, implements, equipment, appliances,

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or tools not consumed or incorporated in performance of the Subcontract Work, and furnished by, belonging to, or delivered to the Project by or on behalf of Subcontractor, shall be returned to Subcontractor in substantially the same condition as when they were taken, normal wear and tear excepted.

10.2 BANKRUPTCY

10.2.1 TERMINATION ABSENT CURE If Subcontractor files a petition under the Bankruptcy Code, this Agreement shall terminate if: (a) Subcontractor or Subcontractor's trustee rejects the Agreement; (b) a default has occurred, and Subcontractor is unable to give adequate assurance of required performance; or (c) Subcontractor is otherwise unable to comply with the requirements for assuming this Agreement under the applicable provisions of the Bankruptcy Code.

10.2.2 INTERIM REMEDIES If Subcontractor is not performing in accordance with the Progress Schedule at the time a petition in bankruptcy is filed, or at any subsequent time, Constructor, while awaiting the decision of Subcontractor or its trustee to reject or to assume this Agreement and provide adequate assurance of its ability to perform, may avail itself of such remedies under this article as are reasonably necessary to maintain the Progress Schedule. Constructor may offset against any sums due or to become due Subcontractor all costs incurred in pursuing any of the remedies provided including, but not limited to, reasonable overhead, profit, and attorneys' fees. Subcontractor shall be liable for the payment of any amount by which costs incurred may exceed the unpaid balance of the Subcontract Amount.

10.3 SUSPENSION BY OWNER FOR CONVENIENCE Should Owner suspend the Work or any part which includes the Subcontract Work for the convenience of Owner and such suspension is not due to any act or omission of Constructor, or any other person or entity for whose acts or omissions Constructor may be liable, Constructor shall notify Subcontractor in writing and, upon receiving notification, Subcontractor shall immediately suspend the Subcontract Work. To the extent provided for under the Prime Agreement and to the extent Constructor recovers such on Subcontractor's behalf, the Subcontract Amount and the Subcontract Time shall be equitably adjusted by Subcontract Change Order for the cost and delay resulting from any such suspension. Constructor agrees to cooperate with Subcontractor, at Subcontractor's expense, in the prosecution of any Subcontractor claim arising out of an Owner suspension and to permit Subcontractor to prosecute the claim, in the name of Constructor, for the use and benefit of Subcontractor.

10.4 TERMINATION BY OWNER Should Owner terminate its contract with Constructor or any part which includes the Subcontract Work, Constructor shall notify Subcontractor in writing within three (3) Business Days of the termination and, upon written notification, this Agreement shall be terminated and Subcontractor shall immediately stop the Subcontract Work, follow all of Constructor's instructions, and mitigate all costs. In the event of Owner termination, Constructor's liability to Subcontractor shall be limited to the extent of Constructor's recovery on Subcontractor's behalf under the Subcontract Documents, except as otherwise provided in this Agreement. Constructor agrees to cooperate with Subcontractor, at Subcontractor's expense, in the prosecution of any Subcontractor claim arising out of Owner termination and to permit Subcontractor to prosecute the claim, in the name of Constructor, for the use and benefit of Subcontractor, or assign the claim to Subcontractor. If Owner terminates Constructor for cause, through no fault of Subcontractor, Subcontractor shall be entitled to recover from Constructor its reasonable costs arising from the termination of this Agreement, including reasonable overhead and profit on Work not performed.

10.5 CONTINGENT ASSIGNMENT OF THIS AGREEMENT Constructor's contingent assignment of this Agreement to Owner, as provided in the Prime Agreement, is effective when Owner has terminated the Prime Agreement for cause and has accepted the assignment by notifying Subcontractor in writing. This contingent assignment is subject to the prior rights of a surety that may be obligated under Constructor's

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bond, if any. Subcontractor consents to such assignment and agrees to be bound to the assignee by the terms of this Agreement, provided that the assignee fulfills the obligations of Constructor.

10.6 SUSPENSION BY CONSTRUCTOR Constructor may order Subcontractor in writing to suspend all or any part of the Subcontract Work for such period of time as may be determined to be appropriate for the convenience of Constructor. Phased Work or interruptions of the Subcontract Work for short periods of time shall not be considered a suspension. Subcontractor, after receipt of Constructor's order, shall notify Constructor in writing in sufficient time to permit Constructor to provide timely notice to Owner in accordance with the Prime Agreement of the effect of such order upon the Subcontract Work. The Subcontract Amount or Subcontract Time shall be adjusted by Subcontract Change Order for any increase in the time or cost of performance of this Agreement caused by such suspension. No claim under this section shall be allowed for any costs incurred more than fourteen (14) Days before Subcontractor's notice to Constructor. Neither the Subcontract Amount nor the Progress Schedule shall be adjusted for any suspension, to the extent that performance would have been suspended, due in whole or in part to the fault or negligence of Subcontractor or by a cause for which Subcontractor would have been responsible. The Subcontract Amount shall not be adjusted for any suspension to the extent that performance would have been suspended by a cause for which Subcontractor would have been entitled only to a time extension under this Agreement.

10.7 WRONGFUL EXERCISE If Constructor wrongfully exercises any option under this article, Constructor shall be liable to Subcontractor solely for the reasonable value of Subcontract Work performed by Subcontractor before Constructor's wrongful action, including reasonable overhead and profit on the Subcontract Work performed, less prior payments made, together with reasonable overhead and profit on the Subcontract Work not executed, and other reasonable costs incurred by such action, including reasonable attorneys' fees.

10.8 TERMINATION BY SUBCONTRACTOR If the Subcontract Work has been stopped for thirty (30) Days because Subcontractor has not received progress payments or has been abandoned or suspended for an unreasonable period of time not due to the fault or neglect of Subcontractor, then Subcontractor may terminate this Agreement upon giving Constructor seven (7) Days' written notice. Upon such termination, Subcontractor shall be entitled to recover from Constructor payment for all Subcontract Work satisfactorily performed but not yet paid for, including reasonable overhead, profit, and attorneys' fees related to termination, costs, and expenses. However, if Owner has not paid Constructor for the satisfactory performance of the Subcontract Work through no fault or neglect of Constructor, and Subcontractor terminates this Agreement under this article because it has not received corresponding progress payments, Subcontractor shall be entitled to recover from Constructor, within a reasonable period of time following termination, payment for all Subcontract Work executed and for any proven loss, cost, or expense in connection with the Work, including all demobilization costs plus reasonable overhead and profit on Subcontract Work not performed. Constructor's liability for any other damages claimed by Subcontractor under such circumstances shall be extinguished by Constructor pursuing said damages and claims against Owner on Subcontractor's behalf as provided for in §10.3 and §10.4.

ARTICLE 11 DISPUTE RESOLUTION

11.1 WORK CONTINUATION AND PAYMENT Subcontractor shall continue the Subcontract Work and maintain the Progress Schedule during any dispute resolution procedure. If Subcontractor continues to perform, Constructor shall continue to make payments in accordance with this Agreement.

11.2 DISPUTES BETWEEN THE PARTIES If the dispute resolution provisions between Constructor and Owner in the Subcontract Documents do not permit consolidation or joinder with disputes of third parties, such as Subcontractor, or if such dispute is only between the Parties, then the Parties shall submit the dispute to the dispute resolution procedures set forth in the section below.

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11.3 CONSTRUCTOR–SUBCONTRACTOR DISPUTE RESOLUTION

11.3.1 DIRECT DISCUSSIONS If the Parties cannot reach resolution on a matter relating to or arising out of the Agreement, the Parties shall endeavor to reach resolution through good faith direct discussions between the Parties' representatives, who shall possess the necessary authority to resolve such matter and who shall record the date of first discussions. If the Parties' representatives are not able to resolve such matter within five (5) Business Days, the Parties' representatives shall immediately inform senior executives of the Parties in writing that a resolution could not be reached. Upon receipt of such notice, the senior executives of the Parties shall meet within five (5) Business Days to endeavor to reach resolution. If the matter remains unresolved after fifteen (15) Days from the date of first discussion, the Parties may pursue their available legal remedies and opinion, including litigation as set forth in this ARTICLE 11.

11.3.2 Not Used

11.3.3 LITIGATION If the matter is unresolved after Direct Discussions, the Parties shall resolve the matter by litigation in either the state or federal court located in Michigan.

11.3.4 NONBINDING DISPUTE RESOLUTION The Parties shall engage in such pretrial dispute resolution proceedings as may be required by the court having jurisdiction over such litigation.

11.3.5 COSTS The costs of litigation and any dispute resolution procedure and reasonable attorneys' fees shall be borne by the non-prevailing Party, as determined by the adjudicator of the dispute.

11.3.6 VENUE Kent County, Michigan shall serve as the venue for resolution of all disputes.

11.4 MULTIPARTY PROCEEDING All parties necessary to resolve a matter agree to be parties to the same dispute resolution proceeding, if possible. To the extent disputes between the Parties involve in whole or in part disputes between Constructor and Owner, disputes between Subcontractor and Constructor shall be decided by the same tribunal and in the same forum as disputes between Constructor and Owner.

11.5 NO LIMITATION OF RIGHTS OR REMEDIES Except as expressly waived, this article does not limit any rights or remedies which Subcontractor may possess under lien laws or payment bonds.

ARTICLE 12 MISCELLANEOUS

12.1 EXTENT OF AGREEMENT Except as specifically provided, this Agreement is for the exclusive benefit of the Parties, and not for the benefit of any third party. This Agreement represents the entire and integrated agreement between the Parties, and supersedes all prior negotiations, representations, or agreements, either written or oral.

12.2 ASSIGNMENT OF SUBCONTRACT WORK Except as provided in §8.10, Subcontractor shall neither assign the whole nor any part of the Subcontract Work without prior written approval of Constructor.

12.3 GOVERNING LAW The Law in effect at the location of the Project shall govern this Agreement.

12.4 SEVERABILITY The partial or complete invalidity of any one or more provisions of this Agreement shall not affect the validity or continuing force and effect of any other provision.

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12.5 NOTICE Unless changed in writing, a Party's address indicated in Article 1 shall be used when delivering notice to a physical address. Except for Agreement termination and as otherwise specified in the Contract Documents, notice is effective upon transmission by any effective means, including overnight delivery service.

12.6 NO WAIVER OF PERFORMANCE Either Party's failure to insist upon any performance of any term, covenant, or condition of this Agreement, or to exercise any of its rights, shall not be construed as a waiver or relinquishment of such term, covenant, condition, or right.

12.7 TITLES Titles given to articles and sections of this Agreement are for ease of reference only and shall not be relied upon or cited for any other purpose.

12.8 JOINT DRAFTING The Parties expressly agree that this Agreement was jointly drafted, and that they both had opportunity to negotiate its terms and to obtain the assistance of counsel in reviewing its terms before execution. Therefore, this Agreement shall be construed neither against nor in favor of either Party, but shall be construed in a neutral manner.

ARTICLE 13 SUBCONTRACT DOCUMENTS

13.1 INTERPRETATION OF SUBCONTRACT DOCUMENTS

13.1.1 The drawings and specifications are complementary. If Work is shown only on one but not on the other, Subcontractor shall perform the Subcontract Work as though fully described on both consistent with the Subcontract Documents and reasonably inferable from them.

13.1.2 In case of conflicts between drawings and specifications, the specifications shall govern. In any case of omissions or errors in figures, drawings, or specifications, Subcontractor shall immediately submit the matter to Constructor for clarification by Owner. Subject to an equitable adjustment in Subcontract Time or Subcontract Amount pursuant to ARTICLE 7 or ARTICLE 11, Owner's clarifications are final and binding.

13.1.3 Where figures are given, they shall be preferred to scaled dimensions.

13.1.4 Unless otherwise specifically defined in this Agreement, any terms that have well-known technical or trade meanings shall be interpreted in accordance with their well-known meanings.

13.1.5 ORDER OF PRECEDENCE In case of any inconsistency, conflict, or ambiguity among the Subcontract Documents, the documents shall govern in the following order: (a) Subcontract Change Orders and written amendments to this Agreement; (b) this Agreement; (c) subject to §13.1.2, the drawings (large scale governing over small scale), specifications, and addenda issued before the execution of this Agreement; (d) information furnished by Owner that is identified as a Subcontract Document; (e) other documents listed in this Agreement. Among categories of documents having the same order of precedence, the term or provision that includes the latest date shall control.

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CONSTRUCTOR
Fishbeck

BY: _____

PRINT NAME: _____

PRINT TITLE: _____

WITNESS: _____

NAME: _____

TITLE: _____

SUBCONTRACTOR:

BY: _____

PRINT NAME: _____

PRINT TITLE: _____

WITNESS: _____

NAME: _____

TITLE: _____

END OF DOCUMENT.

DRAFT

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END OF SECTION 00 52 00

SECTION 00 55 00 – NOTICE TO PROCEED

Dated _____, 20____

TO: _____
(Contractor)

ADDRESS: _____

_____

CONTRACT: Van Buren Charter Township – The Lakeside Park
Van Buren Township, Michigan
Project Number 2500281

You are notified that the Contract Times under the above Contract will commence to run on _____, 20___. By that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 4 of the Agreement the date of Substantial Completion is _____, 20___ and the date of readiness for final payment is _____, 20___.

Also, before you may start any Work at the Site, you must:

Sign and Return the Contract
Submit Insurance Certificates per Article 9.2 of the Agreement
Submit Payment and Performance Bonds per Article 9.3 of the Agreement
Submit a Schedule of Values (SOV)
Submit a company Safety Manual, Safety Data Sheets (if applicable) and Silica Control
Complete and Return Subcontractor Information Sheet

Van Buren Charter Township

By: _____
(Authorized Signature)

_____
(Name and Title)

*Typed or printed in ink

Copy to Engineer

END OF SECTION 00 55 00

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SECTION 00 61 14 – PERFORMANCE BOND FORM

Any singular reference to Subcontractor, Surety, Construction Manager or other party shall be considered plural where applicable.

Subcontractor (Name and Address):

_____

_____

Surety (Name and Address of Principal Place of Business):

_____

_____

Construction Manager:

Fishbeck
1515 Arboretum Drive, SE
Grand Rapids, MI 49546

CONTRACT

Date (Date of Notice of Award): _____
Amount: _____
Description: Van Buren Charter Township – The Lakeside Park
Van Buren Township, Michigan

BOND

Bond Number: _____
Date (Not earlier than Contract Date): _____
Amount: _____
Modifications to this Bond form: _____

Surety and Subcontractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

Subcontractor AS PRINCIPAL

_____ (Seal)
Subcontractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature (Attach Power of Attorney)

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

IMPORTANT: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in in the state where the project is located. Attach Power of Attorney for those signatures executing for Surety, certifying authority to bind the Surety as of the date of the Bond:

1. Subcontractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to Construction Manager for the performance of the Contract, which is incorporated herein by reference.

2. If Subcontractor performs the Contract, the Surety and Subcontractor have no obligation under this Bond, except to participate in conferences as provided in paragraph 3.1.

3. If there is no Construction Manager Default, the Surety's obligation under this Bond shall arise after:

3.1. Construction Manager has notified Subcontractor and Surety at the addresses described in Paragraph 10 below, that Construction Manager is considering declaring a Subcontractor Default and has requested and attempted to arrange a conference with Subcontractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Construction Manager, Subcontractor and Surety agree, Subcontractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Construction Manager's right, if any, subsequently to declare a Subcontractor Default; and

3.2. Construction Manager has declared a Subcontractor Default and formally terminated Subcontractor's right to complete the Contract. Such Subcontractor Default shall not be declared earlier than 20 days after Subcontractor and Surety have received notice as provided in paragraph 3.1; and

3.3. Construction Manager has agreed to pay the Balance of the Contract Price to:

3.3.1. Surety in accordance with the terms of the Contract; or

3.3.2. Another Subcontractor selected pursuant to paragraph 4.3 to perform the Contract.

4. When Construction Manager has satisfied the conditions of Paragraph 3, Surety shall promptly and at Surety's expense take one of the following actions:

4.1. Arrange for Subcontractor, with consent of Construction Manager, to perform and complete the Contract; or

4.2. Undertake to perform and complete the Contract itself, through its agents or through independent Subcontractors; or

4.3. Obtain bids or negotiated proposals from qualified Subcontractors acceptable to Construction Manager for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Construction Manager and Subcontractor selected with Construction Manager's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Construction Manager the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Construction Manager resulting from Subcontractor Default; or

4.4. Waive its right to perform and complete, arrange for completion, or obtain a new Subcontractor, and with reasonable promptness under the circumstances:

4.4.1. After investigation, determine the amount for which it may be liable to Construction Manager and, as soon as practicable after the amount is determined, tender payment therefore to Construction Manager; or

4.4.2. Deny liability in whole or in part and notify Construction Manager citing reasons therefore.

5. If Surety does not proceed as provided in paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Construction Manager to Surety demanding that Surety perform its obligations under this Bond, and Construction Manager shall be entitled to enforce any remedy available to Construction Manager. If Surety proceeds as provided in Subparagraph 4.4, and Construction

Manager refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Construction Manager shall be entitled to enforce any remedy available to Construction Manager.

6. After Construction Manager has terminated Subcontractor's right to complete the Contract, and if Surety elects to act under paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of Surety to Construction Manager shall not be greater than those of Subcontractor under the Contract, and the responsibilities of Construction Manager to Surety shall not be greater than those of Construction Manager under the Contract. To the limit of the amount of this Bond, but subject to commitment by Construction Manager of the Balance of the Contract Price to mitigation of costs and damages on the Contract, the Surety is obligated without duplication for:

6.1. The responsibilities of Subcontractor for correction of defective Work and completion of the Contract;

6.2. Additional legal, design professional and delay costs resulting from Subcontractor's Default, and resulting from the actions of or failure to act of Surety under Paragraph 4; and

6.3. Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Subcontractor.

7. Surety shall not be liable to Construction Manager or others for obligations of Subcontractor that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than Construction Manager or its heirs, executors, administrators or successors.

8. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and shall be instituted within 2 years after Subcontractor Default or within 2 years after Subcontractor ceased working or within 2 years after Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to Surety, Construction Manager or Subcontractor shall be mailed or delivered to the address indicated on the signature page.

11. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions:

12.1. Balance of the Contract Price: The total amount payable by Construction Manager to Subcontractor under the Contract after all proper adjustments have been made, including allowance to Subcontractor of any amounts received or to be received by Construction Manager in settlement of insurance or other Claims for damages to which Subcontractor is entitled, reduced by all valid and proper payments made to or on behalf of Subcontractor under the Contract.

12.2. Contract: The agreement between Construction Manager and Subcontractor identified on the signature page, including all Contract Documents and changes thereto.

12.3. Subcontractor Default: Failure of Subcontractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

12.4. Construction Manager Default: Failure of Construction Manager, which has neither been remedied nor waived, to pay Subcontractor as required by the Contract or to perform and complete or comply with the other terms thereof.

END OF SECTION 00 61 14

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SECTION 00 61 15 – PAYMENT BOND FORM

Any singular reference to Subcontractor, Surety, Construction Manager or other party shall be considered plural where applicable.

Subcontractor (Name and Address):

_____

_____

Surety (Name and Address of Principal Place of Business):

_____

_____

Construction Manager:

Fishbeck
1515 Arboretum Drive, SE
Grand Rapids, MI 49546

CONTRACT

Date (Date of Notice of Award): _____
Amount: _____
Description: Van Buren Charter Township – The Lakeside Park
Van Buren Township, Michigan

BOND

Bond Number: _____
Date (Not earlier than Contract Date): _____
Amount: _____
Modifications to this Bond Form: _____

Surety and Subcontractor, intending to be legally bound hereby, subject to the following terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

Subcontractor AS PRINCIPAL

_____ (Seal)
Subcontractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature (Attach Power of Attorney)

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

IMPORTANT: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located. Attach Power of Attorney for those signatures executing for Surety, certifying authority to bind Surety as of the date of the Bond.

1. Subcontractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to Construction Manager to pay for labor, materials and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to Construction Manager, this obligation shall be null and void if Subcontractor:

2.1. promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2. defends, indemnifies and holds harmless Construction Manager from all claims, demands, liens or suits alleging non-payment by Subcontractor by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract, provided Construction Manager has promptly notified Subcontractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to Subcontractor and Surety, and provided there is no Construction Manager Default.

3. With respect to Claimants, this obligation shall be null and void if Subcontractor promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

4.1. Claimants who are employed by or have a direct contract with Subcontractor have given notice to Surety (at the addresses described in paragraph 12) and sent a copy, or notice thereof, to Construction Manager, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2. Claimants who do not have a direct contract with Subcontractor:

4.2.1. Have furnished written notice to Subcontractor and sent a copy, or notice thereof, to Construction Manager, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and

4.2.2. Have either received a rejection in whole or in part from Subcontractor, or not received within 30 days of furnishing the above notice any communication from Subcontractor by which Subcontractor had indicated the claim will be paid directly or indirectly; and

4.2.3. Not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Construction Manager, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Subcontractor.

5. If a notice required by Paragraph 4 is given by Construction Manager to Subcontractor or to Surety, that is sufficient compliance.

6. Reserved.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

8. Amounts owed by Construction Manager to Subcontractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Subcontractor furnishing and Construction Manager accepting this Bond, they agree that all funds earned by Subcontractor in the performance of the Contract are dedicated to satisfy obligations of Subcontractor and Surety under this Bond, subject to Construction Manager's priority to use the funds for the completion of the Work.

9. Surety shall not be liable to Construction Manager, Claimants or others for obligations of Subcontractor that are unrelated to the Contract. Construction Manager shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant give the notice required by paragraph 4.1 or paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to Surety, Construction Manager or Subcontractor shall be mailed or delivered to the addresses indicated on the signature page. Actual receipt of notice by Surety, Construction Manager or Subcontractor, however accomplished, shall be sufficient compliance as of the date received at the address indicated on the signature page.

13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Subcontractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS:

15.1. Claimant: An individual or entity having a direct contract with Subcontractor or with a first-tier Subcontractor of Subcontractor, to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Subcontractor and Subcontractor's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

15.2. Contract: The agreement between Construction Manager and Subcontractor identified on the signature page, including all Contract Documents and changes thereto.

15.3. Construction Manager Default: Failure of Construction Manager, which has neither been remedied nor waived, to pay Subcontractor as required by the Contract, or to perform and complete or comply with the other terms thereof.

END OF SECTION 00 61 15

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SECTION 00 65 16 – CERTIFICATE OF SUBSTANTIAL COMPLETION FORM

Date of Issuance: _____

Owner: _____

Contractor: _____

Contract: Van Buren Charter Township – The Lakeside Park
Van Buren Township, Michigan
Project Number 2500281

This definitive Certificate of Substantial Completion applies to all Work under the Contract Documents: _____
_____
_____].

_____
Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Project or portion thereof designated above is hereby declared and is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below:

A definitive list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in such list does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by Contractor within 14 days of the above Date of Substantial Completion.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as provided in the Contract Document, except as amended as follows:

Owner's Amended Responsibilities: _____
_____
_____

Contractor's Amended Responsibilities: _____
_____
_____

The following documents are attached to and made a part of this Certificate:

1. List of items to be completed or corrected before final payment.

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Executed by Engineer on _____
Date

_____
Engineer

By: _____
(Authorized Signature)

Contractor accepts this Certificate of Substantial Completion on _____
Date

_____
Contractor

By: _____
(Authorized Signature)

Owner accepts this Certificate of Substantial Completion on _____
Date

_____
Owner

By: _____
(Authorized Signature)

END OF SECTION 00 65 16

SECTION 00 65 26 – AFFIDAVIT AND CONSENT OF SURETY

STATE OF MICHIGAN)
) ss.
COUNTY OF _____)

The undersigned Subcontractor, being duly sworn, deposes and says that they entered into an Agreement (Contract) with Fishbeck (Construction Manager), on the _____ day of _____ 20__, for the performance of certain Work generally described as follows: Van Buren Charter Township – The Lakeside Park.

Subcontractor further says that the Work under the terms of the Contract has been completed and all sums due to Subcontractors, Sub-subcontractors, Suppliers and laborers with whom Subcontractor has contracted for performance under the Contract have been paid in full.

Furthermore, in consideration of final payment under the Contract, Subcontractor hereby waives and releases any and all claims or rights which Subcontractor may have in connection with the Contract against Construction Manager or the premises upon which the Work was performed, and agrees to indemnify Owner and Construction Manager against any and all such claims or rights which may be asserted by Subcontractors, Sub-subcontractors, Suppliers or laborers with whom Subcontractor has contracted for performance under the Contract.

Signed in the presence of:

_____ _____
Subcontractor*

_____ _____
Signature

_____
Name and Title*

Subscribed and sworn to before me this _____ day of _____, 20__.

_____

Notary Public _____

My commission expires:_____ County _____

CONSENT OF SURETY

The undersigned, as Surety on the Contract, hereby consents to the making of final payment to the Subcontractor under the Contract.

Date:_____, 20__

_____
Surety Company*

_____
Attorney-in-Fact (Signature)

_____
Name and Title*

*Typed or printed in ink.

(Attach copy of power of attorney certified to date of consent.)

END OF SECTION 00 65 26

SECTION 01 11 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work covered by the Contract Documents comprises construction the new Lake House, Lake Hall, and all associated sitework and landscaping of The Lakeside Park located at Belleville Road, Van Buren Township, Michigan for Van Buren Charter Township, Owner.

1.3 TYPE OF CONTRACT

A. Construct the Work of this Contract under a single lump sum Contract.

1.4 GENERAL

A. Imperative Language: These Specifications (Divisions 01 through 49) are written in the imperative and abbreviated form. This imperative language of the technical specifications is directed at Subcontractor unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall", "shall be" and similar mandatory phrases by inference in the same manner as they are applied to notes on Drawings. The words "shall", "shall be" and similar mandatory phrases shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated in the imperative or otherwise.

B. Related Sections: Some Sections of these Specifications (Divisions 01 through 49) may include a paragraph titled "Related Sections". This paragraph is an aid to the Project Manual user and is not intended to include all Sections which may be related. It is Subcontractor's obligation to coordinate all Sections whether indicated under "Related Sections" or not.

C. Reference to General Conditions: In Divisions 0 through 49, all references to General Conditions and Supplemental Conditions throughout the Contract Document shall mean the Agreement.

1.5 WORK BY OWNER

A. The following items will be furnished and installed by Owner:
   1. Playground equipment.
   2. Splashpad.
   3. Site furnishings.
   4. Central/Plaza Sculpture.
   5. Interior furnishings.
   6. Food Service/ Warming Kitchen equipment.

B. Coordinate the schedule of work by Owner with Owner and Construction Manager.

1.6 BID CATEGORY DESCRIPTIONS

A. Bid Category 03-100 – Concrete: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

03 11 00 - Concrete Forming
03 15 00 - Concrete Accessories
03 15 16 - Post-Installed Anchors
03 21 00 - Reinforcing Steel
03 31 00 - Structural Concrete
07 21 00 – Thermal Insulation
32 13 13 – Concrete Paving
32 13 14 – Concrete Walks
32 16 13 - Concrete Curbs and Gutters

1. Clarifications:
   a. Includes fine grade and final compaction, including the supplying of additional or removal of excess materials as needed prior to placing concrete slabs, notify construction manager of major grade discrepancies.
   b. Provide all interior and exterior concrete equipment foundations, housekeeping pads and generator pads. Coordinate size, embeds and location requirements with the respective trade contractors.
   c. Coordinate excavation and backfill for all concrete foundations, retaining walls and grade beams with bid category 31-100 Earthwork and Site Utilities.
   d. Provide and apply all required concrete cure and seal as specified. Do not apply where a conflict with other finishes is apparent or present. Coordinate with construction manager and other appropriate trades.
   e. Schedule all required soils or concrete testing and inspection through the construction manager to prevent project delays.
   f. Concrete truck clean out to be in designated area as directed by the construction manager. Concrete Subcontractor to clean designated area and remove off-site and dispose of in a legal manner at the end of concrete work.
   g. Includes all footings, foundation walls, slab on grade and supported slabs.
   h. Includes all exterior concrete pavement, reinforced concrete pavement, sidewalks, curb and gutter, sidewalk keyways into curbs, concrete stairs, steps, ramps, landings, screen walls, cheek walls, concrete planters, and playable fountain concrete.
   i. Include concrete ballast at sanitary sewer grinder pump station.
   j. Additives must be approved prior to use.
   k. Provide and install all detectable warning strips.
   l. Install all pipe bollards, gate posts, and other embedded items furnished by others.
   m. Install all embedded items furnished by other trades.
   n. Furnish and install all mesh and reinforcing steel.
   o. Furnish and install all waterstops and waterproofing.
   p. Furnish and install all required expansion and control joints.
   q. Provide all necessary heat, including fuel, and weather protection for completion of your work.
   r. Provide all perimeter foundation insulation and protection board.
   s. Furnish and install all drilling, reinforcing and doweling for foundation tie-in.
   t. Install all anchor bolts furnished by others.
   u. Grout base plates.
   v. Furnish and install vapor barrier beneath slab.
   w. Fine grade and proof roll gravel base prior to placing paving, notify Construction Manager of any grade or compaction discrepancies.
   x. Maintain streets during trucking operations. Provide all traffic control, flagmen etc. as required.
   y. Include damproofing of concrete foundation walls.
2. Excludes:
   a. Concrete testing by Construction Manager
   b. Survey and Staking by Construction Manager.
   c. Concrete foundation for Sky Ring Structure by bid category 05-200 Canopy/Sky Ring.

d. Grouting of pipe supports by bid category 23-100 Plumbing and HVAC.
e. Site light pole bases by bid category 26-100 Electrical, Security, and Audio Visual.
f. Precast structures by bid category 31-100 Earthwork and Site Utilities.
g. Gravel base and rough grading by bid category 31-100 Earthwork and Site Utilities.
h. Handicap parking signs and posts by bid category 31-100 Earthwork and Site Utilities.
i. Site demolition for to remove existing concrete paving and sidewalk by bid category 31-100 Earthwork and Site Utilities.
j. Concrete piers for Boardwalk, Boat Docks, and Fishing Pier by bid category 35-100 Boardwalk, Boat Dock, and Fishing Pier,
k. Concrete footings/foundations for ornamental fence by bid category 05-100 Structural Steel and Miscellaneous Metals.

B. Bid Category 04-100 – Masonry: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

04 20 00 – Masonry Accessories
04 42 00 – Exterior and Interior Stone Cladding
07 21 00 – Thermal Insulation

1. Clarifications:
   a. Furnish and install all horizontal and vertical reinforcing steel and anchors embedded in masonry.
   b. Furnish and install all required flashings, weeps, vents and other accessories embedded in masonry work.
   c. Coordinate all wall openings for louvers, fans, doors and windows.
   d. Receive, unload and install all lintels, anchors, bearing plates, angles, pipe sleeves and embedded items supplied by others to be installed in masonry.
   e. Furnish and install all bond beams, including concrete, reinforcing steel and related anchor bolts.
   f. Furnish dumpsters and legally dispose of construction debris of this trade.
   g. Provide all necessary heat, including fuel, and weather protection for completion of your work.
   h. Furnish and install all masonry cavity wall insulation.
   i. Construction of mock-up panels.
   j. Grout masonry under new steel beam ends, etc. in masonry walls as required.
   k. Grout beam pockets after installation of beams as shown or specified.
   l. Fire safing and fire caulking as it relates to this trades work.
   m. Furnish and install dampproofing and air/vapor barriers in masonry cavity walls, etc. on all exterior walls.
   n. Clean and wash all masonry as specified and in accordance with approved sample. Protect any adjacent surfaces.
   o. Provide all required shoring for your work.
   p. Includes building signage etched into stone masonry as shown in project documents.
   q. Include masonry and stone cap for dumpster enclosure.
   r. Coordinate loose lock flashing embedded into coping with bid category 07-100 Roofing.
   s. Coordinate with bid category 04-100 to install sealant at weather barrier penetrations for limestone split tie anchors.
   t. Include insulation over exterior metal stud frame walls behind limestone veneer.
2. Excludes:
   a. Caulking and sealants for control joints.
   b. Masonry testing.

C. Bid Category 05-100 – Structural Steel and Miscellaneous Metals: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

05 12 00 – Structural Steel Framing
05 30 00 – Metal Decking
05 50 00 – Metal Fabrications
05 51 33 – Metal Ladders
05 52 00 – Handrails
05 52 13 – Pipe and Tube Railings
10 75 00 – Site Furnishings

1. Clarifications:
   a. Furnish and install all structural steel as shown, specified or as necessary to complete the work.
   b. Furnish and install all miscellaneous steel as shown, specified or as necessary to complete the work.
   c. Furnish all steel embedded in concrete or masonry – to be installed by others- including but not limited to:
      1) Bollards
      2) Dumpster gate posts
   d. Includes interior guardrail with swinggate.
   e. Includes gates for dumpster enclosure.
   f. Includes exterior handrails (including concrete coring as needed).
   g. Includes exterior aluminum handrails and guardrails (including Sleeve-Its as shown).
   h. Includes ornamental fencing and gates (including concrete fence post footings).
   i. Includes screen fence enclosures.
   j. Includes roof access ladders.
   k. Includes handrails on fishing pier.
   l. Coordinate boardwalk railing with low voltage handrail lighting system by bid category 26-100 Electrical, Fire Alarm, and Audio Visual.
2. Excludes:
   a. Light gauge metal stud framing.
   b. Installation of miscellaneous steel embedded in concrete or masonry.
   c. Installation of lintels which are not mechanically fastened to other steel.
   d. Concrete and masonry reinforcing steel.

D. Bid Category 05-200 – Sky Ring: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

1. Clarifications:
   a. Includes design and construction of complete Sky Ring structure.
2. Excludes:

E. Bid Category 06-100 – General Trades: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

05 40 00 – Cold-Formed Metal Framing
06 10 00 – Rough Carpentry
06 15 33 – Boardwalk Decking and Railings
06 20 00 – Finish Carpentry
06 41 00 – Architectural Wood Casework
06 64 00 – Plastic Paneling
06 83 16 – Fiberglass Reinforce Paneling

07 21 00 – Thermal Insulation
07 27 00 – Air and Vapor Barriers
07 92 00 – Joint Sealants
07 92 00.01 – Joint Sealants
08 11 13 - Hollow Metal Doors and Frames
08 14 05 – Architectural Wood Doors
08 31 00 - Access Doors and Panels
08 39 00 – Attic Access Doors
08 71 00 - Door Hardware
08 80 00 – Glazing
09 21 16 – Gypsum Board Assemblies
09 51 00 – Acoustical Ceilings
09 54 23 – Linear Metal Ceilings
09 84 00 – Acoustic Room Components
09 84 30 – Sound-Absorbing Wall Units
10 21 13.16 – Plastic-Laminate-Clad Toilet Compartments
10 22 39 – Folding Panel Partitions
10 28 00 - Toilet, Bath, and Laundry Accessories
10 44 00 – Fire Protection Specialties
11 30 13 - Appliances
12 22 16 – Drapery Track and Accessories
12 24 00 – Window Shades
12 36 00 – Countertop and Window Sills

1. Clarifications:
   a. Set all hollow metal frames including doors set in masonry walls.
   b. Furnish and install all wood blocking required for toilet accessories, cabinets, millwork, trim, windows, curtainwall, etc.
   c. Wood furring, backing, blocking, etc. to support built-in items, fixtures, millwork, and other wall supported items. Coordinate with other trades Electrical, Technology, A/V to include all necessary backing and block.
   d. Furnish and install all hollow metal frames and doors, wood doors, and finish hardware as shown and/or specified.
   e. Furnish and install glazing in architectural wood doors.
   f. Furnish all control wiring as required for fully functioning doors including control wiring for security, card readers and overhead door safety devices as specified by hardware schedule.
   g. Includes cash allowances as shown in specification section 01 21 00 Cash Allowances
   h. Include composite deckboard and underlayment at tiered seating, stairs, and ramps.
   i. Furnish and install cedar board installation on dumpster gates.
   j. Coordinate with bid category 09-300 Flooring and Tile and 26-100 Electrical, Fire Alarm, and Audio Visual to integrate recesses within stone with acrylic panel accents and lighting. Provide mockup sample of detail.
   k. Furnish and install Acoustic Room Components – Mobile.
   l. Furnish and install all corner guards/wall protection.
   m. Furnish and install kitchenette island.
   n. Furnish and install all coat shelves/rods.
   o. Furnish and install kitchen appliances as shown in schedule.
   p. Furnish and install drywall aluminum reveal molding as shown.
   q. Coordinate with bid category 04-100 to install sealant at weather barrier penetrations for limestone split tie anchors.
   r. Includes all interior and exterior joint sealants except as noted in exclusions below.
   s. Include all batt and sound insulation as shown and/or specified.
   t. Include insulation in stud cavity of exterior metal stud framed walls.
   u. Include insulation in interior metal framed partitions.
   v. Include foamed in place air barrier sealant.
   w. Coordinate vapor barrier installation with bid category 09-100 Roofing to construct building envelope as a complete system.
   x. Includes mounting of plumbing fixture accessories for Janitor Receptor such as hose bracket, bumper guard plate, wall guard, mop hanger, and strainer.

2. Excludes:
   a. Conduit for control wiring.
   b. Door hardware for doors provided by bid category 08-100 Storefronts and Glazing.
   c. Excludes joint sealants for all penetrations installed as part of bid categories 08-100 Storefronts and Glazing, 21-100 Fire Suppression, 23-100 Plumbing, Heating, Ventilation, and Air Conditioning, 26-100 Electrical, Fire Alarm, and Audio Visual.
   d. Exclude insulation at perimeter of foundation – by bid category 03-100 Concrete.
   e. Exclude insulation over exterior metal stud frame walls – by bid category 04-100 Masonry.
   f. Excludes rough carpentry beams and framing of boardwalk, boat docks and fishing pier – by bid category 35-100 Boardwalk, Boat Dock, and Fishing Pier.
   g. Excludes composite decking of boardwalk, boat docks and fishing pier – by bid category 35-100 Boardwalk, Boat Dock, and Fishing Pier.

F. Bid Category 07-100 – Roofing: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:
   07 21 00 – Thermal Insulation
   07 27 00 – Air and Vapor Barriers
   07 54 19 – Polyvinyl-Chloride (PVC) Roofing
   07 62 00 – Sheet Metal Flashing and Trim
   07 72 00 – Roof Accessories
   07 92 00 – Joint Sealants

1. Clarifications:
   a. Furnish and install all required caulking, flashing, trim and edging related to roofing work.
   b. Coordinate roof openings with other trades.
   c. Includes roof hatch and safety railing system.
   d. Coordinate loose lock flashing embedded into coping with bid category 04-100 Masonry
   e. Include vapor barrier and cover boards.
   f. Coordinate vapor barrier installation with bid category 06-100 General Trades to construct building envelope as a complete system.
2. Excludes:
   a. Furnishing of mechanical roof curbs.

G. Bid Category 08-100 – Storefronts and Glazing: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:
   07 92 00 – Joint Sealants
   08 32 23 – Sliding and Folding Glazed Walls and Doors
   08 41 13 – Aluminum-Framed Entrances
   08 43 13 – Aluminum Framed Storefronts
   08 44 13 – Glazed Aluminum Curtain Walls
   08 71 00 – Door Hardware
   08 80 00 – Glazing
   08 87 23 – Safety and Security Films

1. Clarifications:
   a. Include all caulking of window systems inherit to the warranty of same.
   b. Clean all glass and frames when and as directed by Construction Manager.
   c. Provide protection of all work until final acceptance by the Owner.
   d. Includes water/leak testing of curtainwall system.
   e. Coordinate automatic door opening controls/wiring with installation of doors and curtainwall.
   f. Include glass films. Also include mockup of FLM1for Architect/Owner Approval as shown.
   g. Includes joint sealants for all penetration installed as part of this bid category.

2. Excludes:
   a. Glazing in architectural wood doors by bid category 06-100 General Trades.
   b. Door hardware for doors provided by bid category 06-100 General Trades.

H. Bid Category 09-100 – Painting: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

09 25 23 – Lime Base Plastering
09 82 00 – Wall Coverings
09 91 13 – Exterior Painting
09 91 23 - Interior Painting
09 93 00 - Staining and Transparent Finishing

1. Clarifications:
   a. Prepare all surfaces per manufacturers recommendations.
   b. Includes touch-up of all areas prior to final Owner acceptance.
   c. Supply and install custom graphic vinyl – to be supplied and installed by IMAGE 360.
   d. Includes concrete floor sealer where specified in room finish schedule.
   e. Includes exterior painting of exposed structural lintels.
2. Excludes:
   a. Masonry cleaning.
   b. Pavement markings as shown on civil Drawings.

I. Bid Category 09-300 – Flooring and Tile: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

09 05 61 – Common Work Results for Flooring Preparation
09 30 00 – Tiling
09 65 00 – Resilient Flooring
09 65 13 – Resilient Base and Accessories
09 68 13 - Tile Carpeting
09 68 16 – Sheet Carpeting

1. Clarifications:
   a. Includes all floor preparation.
   b. Furnish and install all vinyl/rubber base in all areas specified.
   c. Final cleaning of finished product as recommended by the manufacturer.
   d. Include all required reducer strips, thresholds and bases.
   e. Test concrete floors for moisture levels and do not apply flooring until acceptable moisture levels are reached.
   f. Include tiles and pedestal system at exterior locations.
   g. Coordinate with bid category 06-100 General Trades and 26-100 Electrical, Fire Alarm, and Audio Visual to integrate recesses within stone with acrylic panel accents and lighting. Provide mockup sample of detail.
2. Excludes concrete floor sealers.

J. Bid Category 21-100 – Fire Suppression: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

07 92 00 – Joint Sealants
21 05 00 - General Fire Suppression Provisions
21 05 03 - Steel Pipe and Fittings for Fire Suppression
21 05 29 - Hangers and Supports for Fire Suppression Piping and Equipment
21 05 31 - Penetrations for Fire Suppression
21 10 00 - Water Based Fire Suppression Systems

1. Clarifications:
   a. Bid Category 31-100 – Earthwork and Site Utilities will install the fire protection water service to into the building to the riser location. Fire Protection scope of work begins at this riser. Coordinate with Construction Manager and Bid Category 31-100 to ensure proper location, elevation, etc.
   b. Includes joint sealants for all penetration installed as part of this bid category
   c. Includes wall mounted fire department connections
   d. Furnish Post Indicator Valves – Coordinate with bid category 31-100 Earthwork and Site Utilities to install as needed.
   e. Coordinate with other trades to allow space for all above ceiling work
   f. Includes custom color concealed head covers in areas shown.
2. Excludes:
   a. Painting of piping valves, fittings, hangers and other supports.

K. Bid Category 23-100 – Plumbing, Heating, Ventilation, and Air Conditioning: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

07 92 00 – Joint Sealants
10 31 00 – Manufactured Fireplaces
22 05 00 – General Plumbing Provisions
22 05 03 – Steel Pipe and Fittings for Plumbing
22 05 06 – Cast Iron Pipe and Fittings for Plumbing
22 05 07 – Plastic Pipe and Fittings for Plumbing
22 05 09 – Copper Pipe and Fittings for Plumbing
22 05 13 – Common Motor Requirements for Plumbing Equipment
22 05 19 – Meters and Gages for Plumbing Piping
22 05 23 – General Duty Valves for Plumbing
22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
22 05 31 – Penetrations for Plumbing
22 05 46 – Sound and Vibration Control for Plumbing
22 05 73 – Testing and Cleaning of Plumbing Systems
22 07 19 – Plumbing Piping Insulation
22 10 00 – Plumbing Piping and Specialties
22 10 23 – Natural Gas Piping System
22 10 29 – Plumbing Pumps
22 36 00 – Domestic Water Heaters
22 40 00 – Plumbing Fixtures
23 01 00 – Operation and Maintenance of HVAC Systems
23 05 00 – General HVAC Provisions
23 05 03 – Steel Pipe and Fittings for HVAC
23 05 13 – Common Motor Requirements for HVAC Equipment
23 05 19 – Meters and Gages for HVAC Piping
23 05 23 – General Duty Valves for HVAC
23 05 29 – Hangers and Supports for HVAC Piping and Equipment
23 05 31 – Penetrations for HVAC
23 05 46 – Sound and Vibration Control for HVAC
23 05 73 – Testing and Cleaning of HVAC Systems

23 05 93 – Testing, Adjusting and Balancing for HVAC
23 07 13 – Duct Insulation
23 07 19 – HVAC Piping Insulation
23 08 00 – Commissioning of HVAC
23 09 00 – Instrumentation and Control for HVAC
23 20 13 - Piping Specialties for HVAC
23 21 13 – Hydronic Piping
23 21 23 – Hydronic Pumps
23 23 00 – Refrigerant Piping
23 25 00 - HVAC Water Treatment
23 31 13 – Metal Ducts
23 33 13 – Dampers
23 34 23 – HVAC Power Ventilators
23 36 00 – Air Terminal Units
23 37 00 - Air Outlets and Inlets
23 52 16 – Condensing Boilers
23 74 43 – Packaged, Outdoor Heating and Cooling Units
23 81 13 – Package Terminal Air Conditioners
23 82 19 – Fan Coil Units
23 83 19 – Radiant Convective Heating Wall Panels

1. Clarifications:
   a. Include all fees and permits as required for your trade.
   b. Include temporary filters at air handling equipment. Temporary filters are to be removed and replaced immediately prior to owner occupancy.
   c. Coordinate concrete equipment pad sizes with bid category 3-1 – Concrete.
   d. Install all underground utilities from five (5) feet from the exterior of the building.
   e. Furnish sleeves to be installed in concrete foundations.
   f. Provide low voltage controls for toilets, faucets, soap dispensers, etc. to be installed by bid category 26-100 Electrical.
   g. Include temporary protective cover for the trench heaters for use during construction and the finish covers.
   h. Include Fireplace and Outdoor Firepit.
   i. Includes cash allowances as shown in specification section 01 21 00 Cash Allowances.
   j. Includes joint sealants for all penetration installed as part of this bid category.
   k. Coordinate outdoor drinking fountain water supply and sanitary sewer lines - to be installed by bid category 31-100 Earthwork and Site Utilities.
   l. Includes plumbing connection of all food service equipment.
   m. Includes water meter/remote readout.
2. Excludes:
   a. Concrete equipment pads by bid category 03-100 – Concrete.
   b. Painting of piping valves, fittings, hangers and other supports.

L. Bid Category 26-100 – Electrical, Fire Alarm, and Audio Visual: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

07 92 00 – Joint Sealants
11 52 13 – Projection Screens
11 52 26 – Projector Lifts
26 05 00 – Common Work Results for Electrical
26 05 20 – Conductors and Cables - 600V and Below
26 05 27 – Grounding and Bonding
26 05 29 – Hangers and Supports for Electrical Systems
26 05 34 – Raceways for Electrical Systems
26 05 35 – Boxes for Electrical Systems
26 05 36 – Cable Trays for Electrical Systems
26 05 43 – Underground Ducts and Raceways for Electrical Systems
26 05 53 – Identification for Electrical Systems

26 05 73 – Overcurrent Protective Device Coordination Study and Arc Flash Risk Assessment
26 08 00 – Commissioning of Electrical Systems
26 08 13 – Electrical Acceptance Testing
26 09 23 – Lighting Control Devices
26 09 30 – Lighting Control Systems
26 24 16 – Panelboards
26 27 26 – Wiring Devices
26 28 00 – Low Voltage Circuit Protective Devices
26 28 20 – Enclosed Switches
26 29 13 – Enclosed Controllers
26 29 23 – Variable Frequency Motor Controllers
26 32 13 – Engine Generators
26 36 23 – Transfer Switches
26 43 05 – Surge Protective Devices
26 50 00 – Lighting
27 01 00 – Operation and Maintenance of Communications Systems
27 05 00 – Common Work Results for Communications Systems
27 05 26 – Grounding and Bonding for Communications Systems
27 05 29 – Hangers and Supports for Communications Systems
27 05 36 – Cable Trays for Communications Systems
27 05 53 – Identification for Communications Systems
27 08 00 – Commissioning Communications Systems
27 11 00 – Communications Equipment Room Fittings
27 13 00 – Communications Backbone Cabling
27 15 00 – Communications Horizontal Cabling
27 16 00 – Communications Connecting Cords, Devices, and Adapters
27 40 00 – Audiovisual Systems Bidding and General Requirements
27 41 16 – Integrated Audiovisual Systems and Equipment
27 41 16.02 – Audiovisual Systems Appendices
28 00 00 – Common Work Results for Electronic Safety and Security
28 01 00 – Operation and Maintenance of Electronic Safety and Security
28 05 26 – Grounding and Bonding for Electronic Safety and Security
28 05 29 – Hangers and Supports for Electronic Safety and Security
28 05 53 – Identification for Electronic Safety and Security
28 13 00 – Access Control
28 23 00 – Video Surveillance System
28 31 00 – Fire Detection and Alarm

1. Clarifications:
   a. Provide temporary jobsite lighting as required.
   b. Provide temporary power service for construction, 200 amp minimum.
   c. Furnish, install, remove and pay for all temporary wiring, equipment switches, panels, connections, and transformers, including Construction Manager's trailer.
   d. Includes all fees and permits as required for your trade.
   e. Includes all testing, start-up and training work to insure proper performance of electrical systems.
   f. Assist Commissioning Agent by providing access to all equipment as necessary and with required paperwork.
   g. Furnish sleeves to be installed in concrete foundations.
   h. Includes site lighting, including excavation, backfill and concrete for light pole bases for the entire site.
   i. Includes concrete fill/protection as required over underground electrical lines.
   j. Includes fire-resistant joint sealants for all electrically associated penetrations.
   k. Provide all access doors required but not shown for access to electrical systems. These must be thoroughly coordinated in areas with linear ceiling panels.
   l. Includes electrical connection to Owner provided food service/warming kitchen equipment.
   m. Coordinate power/controls for window shades to Audio/Visual system.
   n. Coordinate concrete equipment pad sizes with Bid Category 3-1 – Concrete.
   o. Install conduit for control wiring installed by other trades.
   p. Install low voltage controls for toilets, faucets, soap dispensers, etc. - provided by bid category 23-1 Plumbing and HVAC.

q. Coordinate with bid category 06-100 General Trades and 09-300 Flooring and Tile to integrate recesses within stone with acrylic panel accents and lighting. Provide mockup sample of detail.
r. Coordinate installation of low voltage door hardware/card access controls provide by bid category 06-100 General Trades to provide complete working system.
s. Includes cash allowances as shown in specification section 01 21 00 Cash Allowances.
t. Includes joint sealants for all penetrations installed as part of this bid category.

2. Excludes:
   a. Concrete pads required for electrical equipment, transformers and housekeeping.

M. Bid Category 31-100 – Earthwork and Site Utilities: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:

31 10 13 – Site Preparation
31 22 00 – Grading
31 22 16 – Fine Grading
31 23 03 – Excavation and Fill for Utilities
31 23 06 – Excavation and Fill for Structures
31 25 00 – Erosion and Sedimentation Controls
31 37 00 – Riprap
32 11 23 – Aggregate Base Courses
32 12 16 – Asphalt Paving
32 17 23 – Pavement Markings
33 05 30 – Utility Horizontal Directional Drilling
33 10 00 – Water Utilities
33 30 00 – Sanitary Sewerage Utilities
33 32 26 – Submersible Grinder Pump Station
33 34 00 – Sanitary Utility Sewerage Force Mains
33 40 00 – Storm Drainage Utilities
33 46 16 – Subdrainage Piping (Underdrains)
33 46 00 – Underdrainage System
40 05 13 – Process Piping Systems
40 05 23 – Process Valves
46 07 15 – Packaged Submersible Sanitary Pump Station

1. Clarifications:
   a. Call “Miss Dig” prior to any digging operations or starting any work.
   b. Obtain SESC permit and implement and maintain soil erosion, sedimentation and stabilization control as directed within the permit.
   c. Obtain all necessary permits required to complete this scope of work (water taps, sanitary taps, curb cuts, etc.)
   d. Protect existing storm sewer inlets from construction site run-off as required by permit.
   e. Protect all trees, landscaping and existing structures as shown on project documents utilizing tree protection detail.
   f. Remove and Salvage Bench, Trash Bin, Statue, and Light Post as noted on Demolition Plan. Set aside in safe location for Owner.
   g. Strip and stockpile topsoil on site as directed by Construction Manager for reuse as necessary
   h. Provide all tree removal, clearing/grubbing of site as shown on plans and as necessary for performance of your work.
   i. Include roll off mat at project entrance.
   j. Clean roads of any dirt or debris during the course of this contract, on as needed basis or as directed by the Construction Manager.
   k. Provide barricades and warning signs at all open excavations.
   l. Provide all traffic barricades as necessary for work in, under, or adjacent to roadway.
   m. Maintain streets during trucking operations. Provide all traffic control, flagmen etc. as required.
   n. Provide dust control as needed or as directed by the Construction Manager throughout the duration of this contract.
   o. Domestic water service and sanitary sewer utilities to be installed within 5 feet of the exterior of the building. Cap piping and mark above grade.

p. Coordinate installation of outdoor drinking fountain water supply and sanitary sewer lines for bid category 23-100 Plumbing, Heating, Ventilation, and Air Conditioning.
q. Include a 2" water service/RPZ Backflow preventor from Mechanical/Plumbing room inside Lake Hall, through the floor and footing to the exterior for the Landscape Irrigation supply piping.
r. Fire Protection water service to be brought inside the building to the riser. Cap piping above finish floor elevation. Coordinate with Construction Manager and bid category 21-100 Fire Protection.
s. Install Fire Protection Post Indicator Valves – supplied by bid category 21-100 Fire Protection.
t. Provide dewatering as necessary to complete work.
u. Supply and install sleeves under roads, walks, etc. for lawn irrigation system or electrical work. Coordinate with Construction Manager and other trades as required.
v. All earthwork and fine grading required to balance the site to elevations indicated on the drawings and to blend into adjacent areas. Additional fill is the responsibility of this bid category.
w. Provide excavation and backfill for all foundations.
x. Furnish and install underdrains and foundation drains as shown on civil, landscaping, and structural drawings.
y. Prepare sub-base to +/- 1 inch for all concrete slabs; interior and exterior.
z. Prepare all landscaped green areas to be +/- 1 inch of elevations to be ready for topsoil as shown on project documents. Areas must be fully ready to receive topsoil and plantings by Bid Category 32-100 Landscaping.
aa. Prepare all synthetic turf areas to be +/- 1 inch of elevations to be ready for synthetic turf as shown on project documents. Areas must be fully ready to receive synthetic turf by Bid Category 32-100 Landscaping.
bb. Coordinate locations for power, water, and miscellaneous equipment with Owner provided Vortex Splashpad.
cc. Coordinate locations for Owner provided playground equipment.
dd. Furnish and install all site precast structures.
ee. Ensure that work is installed to standards shown on Van Buren Charter Township Miscellaneous Details, Standard SESC Details, Standard Sanitary Sewer Details, Standard Storm Sewer Details, Standard Sidewalk Details, and Standard Water Main Details.
ff. Mill existing wearing course and key in new asphalt where new asphalt meets existing.
gg. Sawcut and remove concrete paving and sidewalk as shown for site demolition. Coordinate with 03-100 Concrete.
hh. Fine grade and proof roll gravel base prior to placing paving, notify Construction Manager of any grade or compaction discrepancies.
ii. Pavement striping and markings as shown and specified.
jj. Furnish and install handicap parking signage and all other site signage as shown on contract documents.
kk. Include precast concrete block retaining wall and guardrails.
ll. Removal of temporary erosion control items at completion of project or as directed by permit.
mm. Includes cash allowances as shown in specification section 01 21 00 Cash Allowances.

2. Excludes:
   a. Underground utilities within the building footprint.
   b. Survey/staking to be provided by Construction Manager. Coordinate with Construction manager to allow time for scheduling.
   c. Boardwalk, Fishing Pier and Boat Docks are to be installed by Bid Category 35-100 Boardwalk, Boat Dock, and Fishing Pier.

N. Bid Category 32-100 – Landscaping: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:
   32 05 36 – Landscape Maintenance and Warranty Standards
   32 14 40.15 – Porcelain Paver Paving
   32 14 50 – Porcelain Unit Paving
   32 18 23.29 – Synthetic Turf Non-Athletic
   32 32 16 – Precast Concrete Retaining Wall System
   32 84 00 – Irrigation System
   32 91 19 – Topsoil
   32 92 19 – Seeding
   32 92 23 – Sodding
   32 93 00 – Plants

   1. Clarifications:
      a. Provide all necessary staking and anchoring of trees and plants.
      b. All landscape maintenance per the specifications and watering required to establish growth.
      c. Coordinate locations for Owner provided playground equipment with synthetic turfgrass.
      d. Furnish and install fall attenuation pad and nailer board for Synthetic Turf.
   2. Excludes: N/A

O. Bid Category 35-100 – Boardwalk, Boat Dock, and Fishing Pier: This bid category includes, but is not limited to, all labor, material, tools, equipment, coordination and supervision to complete all work as indicated on the drawings and as specified in the following sections outlined below. The bid category includes all specification sections of BIDDING REQUIREMENTS, CONTRACT REQUIREMENTS, AND GENERAL REQUIREMENTS OF THE CONTRACT AND THE FOLLOWING SECTIONS:
   06 10 00 – Rough Carpentry
   06 15 33 – Boardwalk Decking and Railings
   31 62 16 – Steel Piles
   31 66 26 – Helical Foundation System

   1. Clarifications:
      a. Provide dewatering as necessary to complete work.
      b. Includes Synthetic Wood Boardwalk, Boat Dock, and Fishing Pier as shown on project documents.
      c. Includes rough carpentry beams and framing of boardwalk, boat docks and fishing pier.
      d. Includes composite decking of boardwalk, boat docks and fishing pier.
      e. Include AGS Stainless Steel Railing system on Boardwalk.
   2. Excludes:
      a. Exclude handrails on fishing pier - by bid category 05-100 Structural Steel and Miscellaneous Metals.

1.7 SUBCONTRACTOR USE OF PREMISES

A. Limit use of premises to allow for work by other Subcontractors.

B. Coordinate use of premises under direction of the Construction Manager.

C. Where the Contract Documents identify certain site elements within the construction limits, such as sidewalks, drives, and streets, that must be kept open for public or the Owner's use during construction, the Subcontractor shall be responsible for protection and maintenance of such elements as well.

D. Except in connection with the safety or protection of persons or the Work or property at the Site or adjacent thereto, all Work at the site shall be restricted to the following hours:
   1. Monday Through Saturday (Except Legal Holidays): 7 a.m. to 6 p.m.
   2. Sundays or legal holidays with written approval of the Owner.

E. Work Within Highway Rights-of-Way: In accordance with Division 01 Section "Regulatory Requirements."

1.8 OCCUPANCY REQUIREMENTS

A. Owner Occupancy During Construction:
   1. The Owner will occupy or utilize premises for installation of Furniture, Playground equipment, Splashpad, Site furnishings, Central/Plaza Sculpture, Interior furnishings, Food Service/ Warming Kitchen equipment.
   2. Cooperate with the Construction Manager to minimize conflict and to facilitate the Owner's operations.
   3. Access to Abutting Properties: Provide at all times.
   4. Access for Emergency Vehicles:
      a. Provide at all times.
      b. Provide at least one clear lane during nonwork periods.
   5. Fire Hydrants: Provide access to at all times.
   6. Do not block fire access routes from buildings.
   7. Detours and Street Closure:
      a. When provided for in the Contract Documents or approved by the Construction Manager.
      b. Routes and barricades as indicated or as approved by road authority.
   8. Limit parking for construction vehicles to an area designated by the Construction Manager.

PART 2 - PRODUCTS

2.1 OTHER MATERIALS

A. General: All other materials which are not specified herein and are not indicated on the Drawings, but are required for proper and complete performance of the Work.

B. Procedure:
   1. Select new, first quality material.
   2. Obtain Construction Manager's review.
   3. Provide and install.

PART 3 - EXECUTION

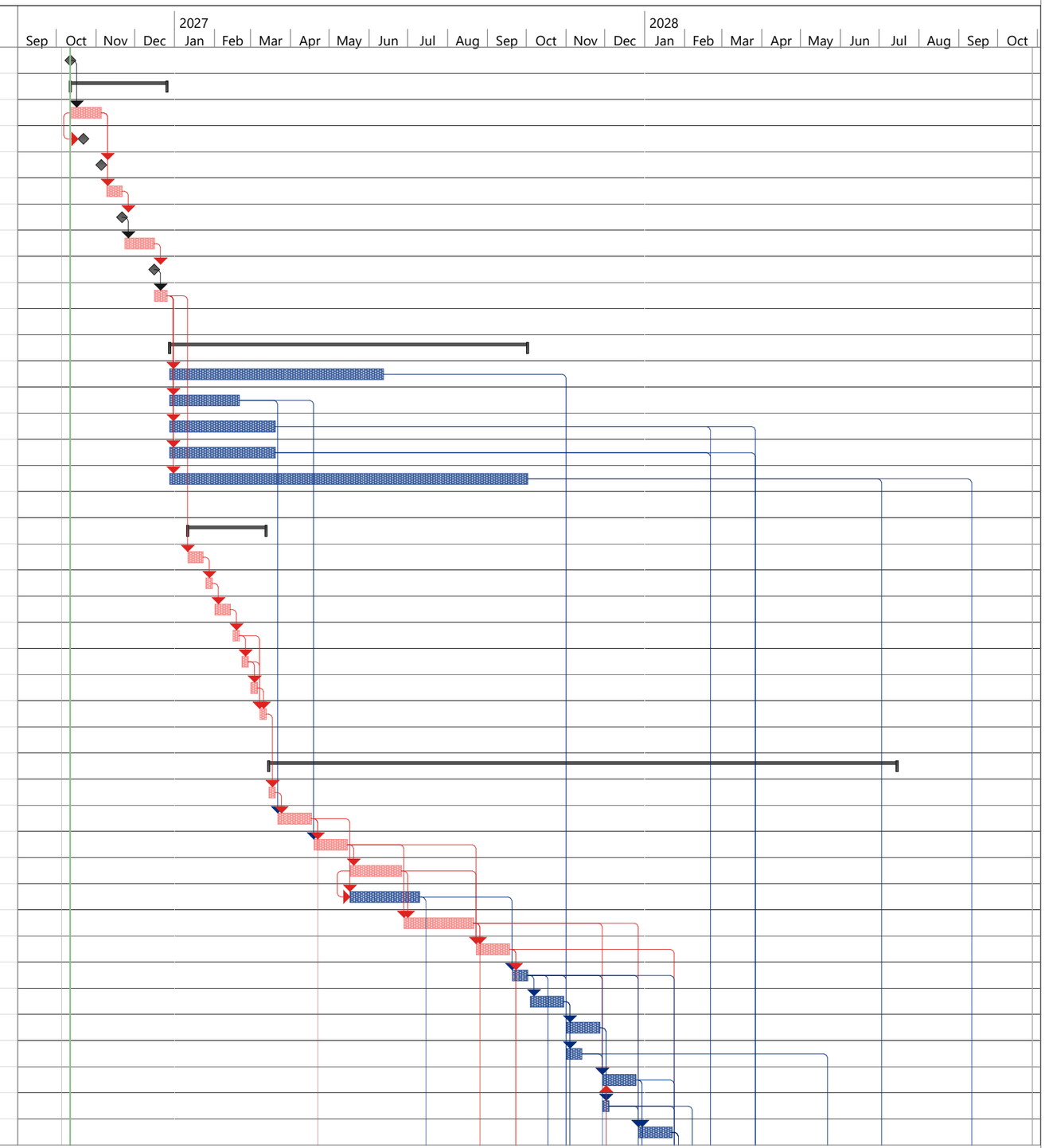
3.1 SCHEDULES

A. See attached schedule following this Section.

END OF SECTION 01 11 00

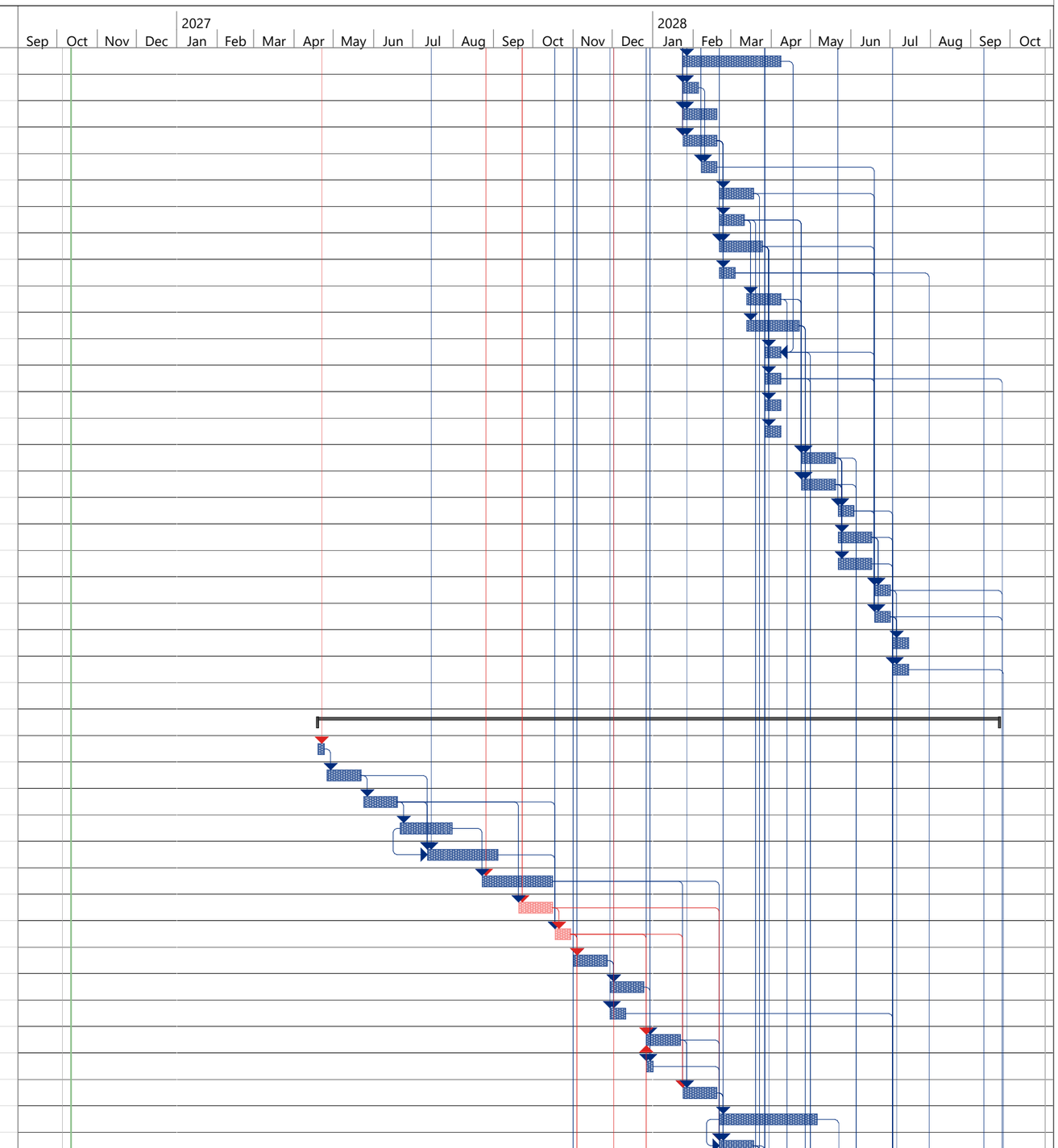
Van Buren Charter Township - The Lakeside Park

ID	Task Name	Duration	Start	Finish
1	Issue Construction Documents	0 days	Mon 10/12/26	Mon 10/12/26
2	**Bidding and Contract Approval**	**55 days**	**Mon 10/12/26**	**Fri 12/25/26**
3	Bidding	18 days	Mon 10/12/26	Wed 11/4/26
4	Pre-Bid Meeting	0 days	Wed 10/21/26	Wed 10/21/26
5	Bid Opening	0 days	Wed 11/4/26	Wed 11/4/26
6	Post Bid Interviews	10 days	Mon 11/9/26	Fri 11/20/26
7	Submit Final Costs for Contract Approval	0 days	Fri 11/20/26	Fri 11/20/26
8	BID HOLD	17 days	Mon 11/23/26	Tue 12/15/26
9	Township Board Meeting for Contract Approval	0 days	Tue 12/15/26	Tue 12/15/26
10	Issue Subcontracts	8 days	Wed 12/16/26	Fri 12/25/26
11				
12	**Submittals and Long Lead Items**	**200 days**	**Mon 12/28/26**	**Fri 10/1/27**
13	Sky Ring Canopy Structure	120 days	Mon 12/28/26	Fri 6/11/27
14	General Submittals/Shop Drawings	40 days	Mon 12/28/26	Fri 2/19/27
15	Electrical Gear	60 days	Mon 12/28/26	Fri 3/19/27
16	HVAC Equipment	60 days	Mon 12/28/26	Fri 3/19/27
17	Furniture	200 days	Mon 12/28/26	Fri 10/1/27
18				
19	**Site Clearing and Initial Site Work**	**45 days**	**Mon 1/11/27**	**Fri 3/12/27**
20	Mobilize to Site	10 days	Mon 1/11/27	Fri 1/22/27
21	SESC Measures installed	5 days	Mon 1/25/27	Fri 1/29/27
22	Strip Topsoil	10 days	Mon 2/1/27	Fri 2/12/27
23	Watermain installation	5 days	Mon 2/15/27	Fri 2/19/27
24	Sanitary Sewer/Force main installation	5 days	Mon 2/22/27	Fri 2/26/27
25	Storm Sewer installation	5 days	Mon 3/1/27	Fri 3/5/27
26	Gravel grade for parking lot	5 days	Mon 3/8/27	Fri 3/12/27
27				
28	**Lake House Construction**	**350 days**	**Mon 3/15/27**	**Fri 7/14/28**
29	Excavation for Lake House Footings	5 days	Mon 3/15/27	Fri 3/19/27
30	Concrete Footings and Foundations	20 days	Mon 3/22/27	Fri 4/16/27
31	Structural Steel and Decking	20 days	Mon 4/19/27	Fri 5/14/27
32	Exterior Envelope Framing and Doors	30 days	Mon 5/17/27	Fri 6/25/27
33	MEP/FP - Underground Rough In	40 days	Mon 5/17/27	Fri 7/9/27
34	Masonry -Limestone Veneer	40 days	Mon 6/28/27	Fri 8/20/27
35	Roofing	20 days	Mon 8/23/27	Fri 9/17/27
36	Concrete - Slab on Grade	10 days	Mon 9/20/27	Fri 10/1/27
37	Interior metal stud walls and door frames	20 days	Mon 10/4/27	Fri 10/29/27
38	MEP/FP - Wall and Ceiling Rough In	20 days	Mon 11/1/27	Fri 11/26/27
39	Operable Partition wall - Rough In	10 days	Mon 11/1/27	Fri 11/12/27
40	Concrete - Exterior Site	20 days	Mon 11/29/27	Fri 12/24/27
41	MEP/FP - Rough In Inspections	5 days	Mon 11/29/27	Fri 12/3/27
42	Aluminum curtainwall and window installation	20 days	Mon 12/27/27	Fri 1/21/28



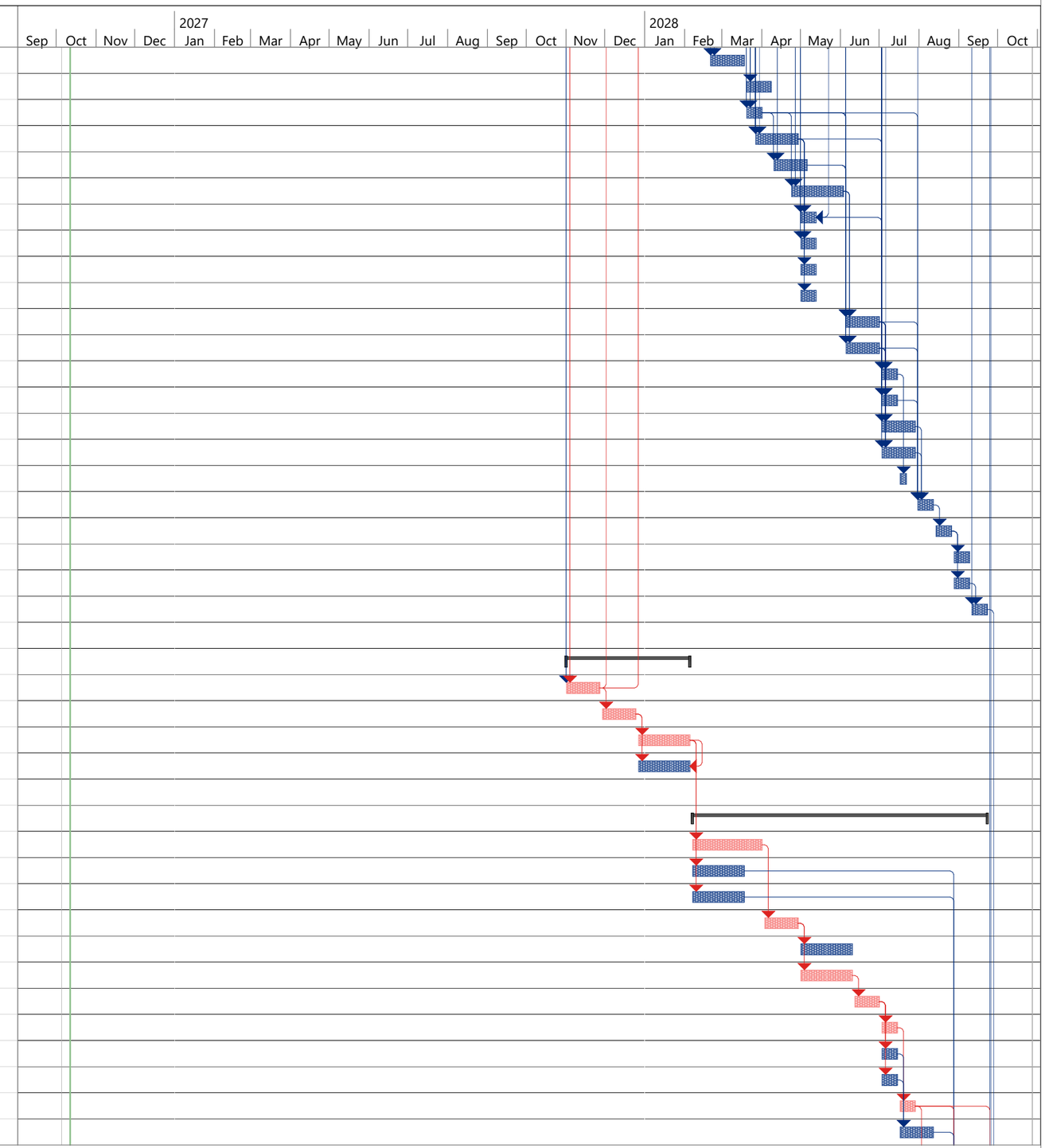
Van Buren Charter Township - The Lakeside Park

ID	Task Name	Duration	Start	Finish
43	Temporary Heat	55 days	Mon 1/24/28	Fri 4/7/28
44	Fireplace - Rough In	10 days	Mon 1/24/28	Fri 2/4/28
45	Exterior Tile	20 days	Mon 1/24/28	Fri 2/18/28
46	Drywall - Hang and Finish	20 days	Mon 1/24/28	Fri 2/18/28
47	Fireplace - Finishes	10 days	Mon 2/7/28	Fri 2/18/28
48	Wall Tile	20 days	Mon 2/21/28	Fri 3/17/28
49	Paint - Prime and First Coat	15 days	Mon 2/21/28	Fri 3/10/28
50	MEP/FP - Finishes	25 days	Mon 2/21/28	Fri 3/24/28
51	Paint and Wall Coverings- Final Coat	10 days	Mon 2/21/28	Fri 3/3/28
52	Ceiling - ACP	20 days	Mon 3/13/28	Fri 4/7/28
53	Ceiling - Linear Metal Plank	30 days	Mon 3/13/28	Fri 4/21/28
54	HVAC Mechanical System - Startup and Testing	10 days	Mon 3/27/28	Fri 4/7/28
55	Lighting System - Startup and Testing	10 days	Mon 3/27/28	Fri 4/7/28
56	Audio Visual - Startup and Testing	10 days	Mon 3/27/28	Fri 4/7/28
57	Fire Alarm - Startup and Testing	10 days	Mon 3/27/28	Fri 4/7/28
58	Flooring - Tile	20 days	Mon 4/24/28	Fri 5/19/28
59	Flooring - Carpet	20 days	Mon 4/24/28	Fri 5/19/28
60	Operable Partition Wall - Finishes	10 days	Mon 5/22/28	Fri 6/2/28
61	Interior doors and hardware	20 days	Mon 5/22/28	Fri 6/16/28
62	Window Shades	20 days	Mon 5/22/28	Fri 6/16/28
63	Final Cleaning	10 days	Mon 6/19/28	Fri 6/30/28
64	MEP/FP - Final Inspections	10 days	Mon 6/19/28	Fri 6/30/28
65	Punchlist - Community Lake House	10 days	Mon 7/3/28	Fri 7/14/28
66	Furniture Installation - Community Lake House	10 days	Mon 7/3/28	Fri 7/14/28
67				
68	**Lake Hall Construction**	**375 days**	**Mon 4/19/27**	**Fri 9/22/28**
69	Excavation for Lake Hall Footings	5 days	Mon 4/19/27	Fri 4/23/27
70	Concrete Footings and Foundations	20 days	Mon 4/26/27	Fri 5/21/27
71	Structural Steel and Decking	20 days	Mon 5/24/27	Fri 6/18/27
72	Exterior Envelope Framing and Doors	30 days	Mon 6/21/27	Fri 7/30/27
73	MEP/FP - Underground Rough In	40 days	Mon 7/12/27	Fri 9/3/27
74	Masonry -Limestone Veneer	40 days	Mon 8/23/27	Fri 10/15/27
75	Roofing	20 days	Mon 9/20/27	Fri 10/15/27
76	Concrete - Slab on Grade	10 days	Mon 10/18/27	Fri 10/29/27
77	Interior metal stud walls and door frames	20 days	Mon 11/1/27	Fri 11/26/27
78	MEP/FP - Wall and Ceiling Rough In	20 days	Mon 11/29/27	Fri 12/24/27
79	Operable Partition wall - Rough In	10 days	Mon 11/29/27	Fri 12/10/27
80	Concrete - Exterior Site	20 days	Mon 12/27/27	Fri 1/21/28
81	MEP/FP - Rough In Inspections	5 days	Mon 12/27/27	Fri 12/31/27
82	Aluminum curtainwall and window installation	20 days	Mon 1/24/28	Fri 2/18/28
83	Temporary Heat - as needed	55 days	Mon 2/21/28	Fri 5/5/28
84	Drywall - Hang and Finish	20 days	Mon 2/21/28	Fri 3/17/28



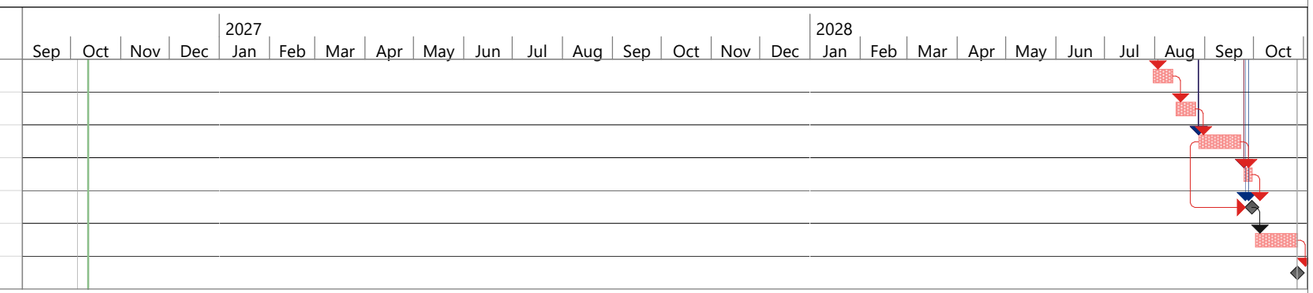
Van Buren Charter Township - The Lakeside Park

ID	Task Name	Duration	Start	Finish
85	Exterior Tile	20 days	Mon 2/21/28	Fri 3/17/28
86	Wall Tile	15 days	Mon 3/20/28	Fri 4/7/28
87	Paint - Prime and First Coat	10 days	Mon 3/20/28	Fri 3/31/28
88	MEP/FP - Finishes	25 days	Mon 3/27/28	Fri 4/28/28
89	Ceiling - ACP	20 days	Mon 4/10/28	Fri 5/5/28
90	Ceiling - Linear Metal Plank	30 days	Mon 4/24/28	Fri 6/2/28
91	HVAC Mechanical System - Startup and Testing	10 days	Mon 5/1/28	Fri 5/12/28
92	Lighting System - Startup and Testing	10 days	Mon 5/1/28	Fri 5/12/28
93	Audio Visual - Startup and Testing	10 days	Mon 5/1/28	Fri 5/12/28
94	Fire Alarm - Startup and Testing	10 days	Mon 5/1/28	Fri 5/12/28
95	Flooring - Tile	20 days	Mon 6/5/28	Fri 6/30/28
96	Flooring - Carpet	20 days	Mon 6/5/28	Fri 6/30/28
97	MEP/FP - Final Inspections	10 days	Mon 7/3/28	Fri 7/14/28
98	Operable Partition Wall - Finishes	10 days	Mon 7/3/28	Fri 7/14/28
99	Interior doors and hardware set	20 days	Mon 7/3/28	Fri 7/28/28
100	Window Shades	20 days	Mon 7/3/28	Fri 7/28/28
101	Audio Visual - startup and testing	5 days	Mon 7/17/28	Fri 7/21/28
102	Paint and Wall Coverings- Final Coat	10 days	Mon 7/31/28	Fri 8/11/28
103	Final Cleaning	10 days	Mon 8/14/28	Fri 8/25/28
104	Food Service Equipment - Lake Hall	10 days	Mon 8/28/28	Fri 9/8/28
105	Punchlist - Lake Hall	10 days	Mon 8/28/28	Fri 9/8/28
106	Furniture Installation - Lake Hall	10 days	Mon 9/11/28	Fri 9/22/28
107				
108	**Sky Ring Canopy Structure**	**70 days**	**Mon 11/1/27**	**Fri 2/4/28**
109	Footings and Foundations	20 days	Mon 11/1/27	Fri 11/26/27
110	Structural Framing	20 days	Mon 11/29/27	Fri 12/24/27
111	Exterior Skin	30 days	Mon 12/27/27	Fri 2/4/28
112	Electrical Elements	30 days	Mon 12/27/27	Fri 2/4/28
113				
114	**Final Sitework and Landscaping**	**165 days**	**Mon 2/7/28**	**Fri 9/22/28**
115	Waterfront Boardwalk	40 days	Mon 2/7/28	Fri 3/31/28
116	Fishing Dock	30 days	Mon 2/7/28	Fri 3/17/28
117	Boat Docks	30 days	Mon 2/7/28	Fri 3/17/28
118	Site Concrete, Terraced Seating, and Sidewalks	20 days	Mon 4/3/28	Fri 4/28/28
119	Pavers	30 days	Mon 5/1/28	Fri 6/9/28
120	Splash Pad and Playground	30 days	Mon 5/1/28	Fri 6/9/28
121	Concrete Curb & Gutter	15 days	Mon 6/12/28	Fri 6/30/28
122	Asphalt Paving - Fine Grading and Base Course	10 days	Mon 7/3/28	Fri 7/14/28
123	Irrigation rough in	10 days	Mon 7/3/28	Fri 7/14/28
124	Topsoil and Seeding	10 days	Mon 7/3/28	Fri 7/14/28
125	Asphalt Paving - Finish/Top Course and Striping	10 days	Mon 7/17/28	Fri 7/28/28
126	Landscaping and irigation startup	20 days	Mon 7/17/28	Fri 8/11/28



Van Buren Charter Township - The Lakeside Park

ID	Task Name	Duration	Start	Finish
127	Sculptural Icon Installation	10 days	Mon 7/31/28	Fri 8/11/28
128	Planters	10 days	Mon 8/14/28	Fri 8/25/28
129	Sitework Punchlist	20 days	Mon 8/28/28	Fri 9/22/28
130	Life Safety Walkthrough/Occupancy Permit	5 days	Mon 9/25/28	Fri 9/29/28
131	Owner Move-In/Substantial Completion	0 days	Fri 9/29/28	Fri 9/29/28
132	Project Closeout	20 days	Mon 10/2/28	Fri 10/27/28
133	Final Completion	0 days	Fri 10/27/28	Fri 10/27/28



SECTION 01 21 13 – CASH ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section provides for cash allowances which are included in the Contract Price.

B. Related Sections include Sections in Divisions 01 through 49, as identified below, provide additional information on what is covered by the respective allowances.

1.3 SCHEDULE OF ALLOWANCES

A. Bid Category 06-100 – General Trades is to include in the Contract Price the following amounts:
   1. The amount of $5,000 for interior room identification and code required signs not specified or shown on project documents. Interior emergency exit signs, exterior building signs, site signs and parking lot signs are not included in this allowance and should be included in the Contractors base bid
   2. The amount of $3,000 to make adjustments to the door hardware specified in Division 08 Section “Door Hardware.” The Contractor’s base bid shall include all of the door hardware specified in Division 08. This allowance is intended to allow the Owner to add or make adjustments to the specified hardware during construction.
   3. The amount of $2,000 for additional miscellaneous caulking per the direction of the Construction Manager in addition to what is shown on the project documents.
   4. The amount of $2,000 for additional miscellaneous blocking per the direction of the Construction Manager in addition to what is shown on the project documents.

B. Bid Category 23-100 – Plumbing, Heating, Ventilation, and Air Conditioning is to include in the Contract Price the following amounts:
   1. The amount of $2,500 to coordinate/connect plumbing to additional Appliances, Owner provided Equipment, and Furniture in addition to what is shown on the project documents.

C. Bid Category 26-100 – Electrical, Fire Alarm, and Audio/Visual is to include in the Contract Price the following amounts:
   1. The amount of $30,000 to connect temporary power to the Fishbeck Construction Trailer, the Lakehouse, and Lake Hall.
   2. The amount of $5,000 to coordinate/connect electrical to additional Appliances, Owner provided Equipment, and Furniture in addition to what is shown on the project documents.
   3. The amount of $2,500 to add 110volt power to the exterior of Lake Hall as needed for Landscape Irrigation controller

D. Bid Category 31-100 – Earthwork and Site Utilities is to include in the Contract Price the following amounts:
   1. The amount of $5,000 to for regrading parking lot and snow removal per the direction of the Construction Manager as needed for safety and jobsite productivity.

1.4 CASH ALLOWANCES

A. Costs Associated With Allowances:
   1. All costs, associated with allowances, which are not specifically defined in the Schedule of Allowances, paragraph 1.3 of this Section shall be included in the Base Bid.
   2. Associated costs not specifically defined in the Schedule of Allowances may include, but are not necessarily limited to:
      a. Unloading.
      b. Handling on the Site.

c. Labor.
d. Installation.
e. Overhead.
f. Profit.

1.5 ADJUSTMENT OF COSTS

A. Change Order: Written to adjust Contract Price if final cost is different from allowance.

B. Documentation:
1. Submit:
a. Within 60 days after completion of the work under the allowance.
b. Documentation of actual costs.
2. Failure to submit claims within the designated time will constitute a waiver of claims for additional costs.
3. At Contract closeout, reflect all approved changes in Contract amounts in the final statement of accounting.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 21 13

SECTION 01 25 13 – PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the administration of substitutions and Product options.

1.3 SUBMITTALS

A. List of all products proposed for installation:
   1. Submit 2 paper copies or 1 electronic copy within 30 days after the Effective Date of Agreement unless otherwise indicated elsewhere in the Contract Documents.
   2. Tabulate the list by each Specification Section.

1.4 SUBCONTRACTOR'S OPTIONS

A. Products specified only by reference standards or by description:
   1. Select any Product meeting the standards or description by any Supplier unless otherwise required elsewhere in the Contract Documents.
   2. Submit for Engineer's review:
      a. Name and address of Supplier.
      b. Trade name.
      c. Model or catalog designation.
      d. Manufacturer's data including:
         1) Performance and test data
         2) Compliance with reference standards.

B. Products specified by naming one or more suppliers without an "or equal" clause:
   1. Use specified Product of one of the Suppliers named.
   2. No substitutions.

C. Products specified by naming one or more suppliers with an "or equal" clause:
   1. Indicates the option of selecting equivalent Products by stating "or equal" after the specified Suppliers.
   2. Engineer may waive some or all of the requirements specified for substitutions if, at Engineer's sole discretion, the proposed equivalent Product is considered an "or equal".
   3. If, at Engineer's sole discretion, the proposed equivalent Product does not qualify as an "or equal", it will be considered as a proposed substitute and a substitution request submittal will be required.

1.5 SUBSTITUTIONS

A. Substitutions after the effective date of agreement:
   1. Within 30 days after the Effective Date of Agreement.
   2. Engineer will consider formal requests for substitution of Products in place of those specified unless otherwise prohibited elsewhere in the Contract Documents.

B. Substitution Request Submittals: Submit 2 paper copies or 1 electronic copy of the request for substitution including the following:
   1. Complete data substantiating compliance of the proposed substitution with the Contract Documents.
   2. For Products:
      a. Names and addresses of Manufacturer and Supplier.
      b. Product identification.

c. Manufacturer's literature, including:
   1) Product description.
   2) Performance and test data
   3) Reference standards.
d. Samples.
e. Name and address of similar projects on which the Product was used and date of installation.

3. For Construction Methods:
   a. Detailed description of the proposed method.
   b. Drawings illustrating methods.
4. Itemized comparison of proposed substitution with Product or method specified.
5. Data relating to changes in the construction schedule.
6. Accurate cost data on the substitution and comparison with the Product or method specified.
7. Changes to the Work which would be caused by the substitution.
8. Complete form attached to this specification section.

C. Subcontractor's Responsibilities: In making a request for a substitution, Subcontractor represents:
   1. Subcontractor has personally investigated the proposed Product or method and determined that it is equal or superior in all respects to that which is specified.
   2. Subcontractor will provide the same guarantee for the substitution as for the Product or method specified.
   3. Subcontractor will coordinate installation of the accepted substitution into the Work making such changes as may be required for the Work to be completed in all respects.
   4. Subcontractor waives all claims for additional cost related to the substitution which consequently become apparent.
   5. Cost data is complete and includes all related costs under Subcontractor's contract, but excludes costs under separate contracts and Engineer's redesign costs.

D. Substitutions Not Considered: Substitutions will not be considered if:
   1. They are indicated or implied on Shop Drawings or Product data submittals without formal request submitted in accordance with this Section.
   2. Acceptance will require substantial revision of the Contract Documents.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 25 13

PRODUCT SUBSTITUTION REQUEST FORM

Project:	Substitution Request No.:
Bid Category Desc:	Bid Category No:
Subcontractor:	Date:
CM Project No.:	
Specification Title:	Section/Page No:
Article/Paragraph/Item:	
Proposed substitution	
Manufacturer:	Model No.:
Address (city/state/zip):	
Telephone No:	
Trade Name:	
History: ☐ New Product ☐ 2-5 years old ☐ 5-10 years old ☐ More than 10 years old	
Reason for proposed substitution:	
Cost Difference: $	Schedule Difference:
Proposed substitution affects other parts of Work: ☐ No ☐ Yes Explain:	
Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Costa Data	
The Undersigned certifies: • Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product. • Same or better Warranty will be furnished for proposed substitution as for originally specified product. • Same or better maintenance service and source of replacement parts, as applicable, is available. • Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule. • Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be borne by submitting subcontractor. • Proposed substitution does not affect dimensions and functional clearances. • Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution. • Coordination, installation, and changes in the Wok as necessary for accepted substitution will be complete in all respects.	
Subcontractor submitting request:	
Address:	
Telephone:	Email:
Signed by:	
A/E's REVIEW AND ACTION	
☐ Substitution approved - Make submittals in accordance with Specification Section 01 33 00.	
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00.	
☐ Substitution rejected - Use specified materials.	
☐ Substitution Request received too late - Use specified materials.	
Signed by:	Date:
Additional Comments: ☐ Construction Manager ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E	

SECTION 01 26 00 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedures for modifying the Contract Documents. All documentation shall be electronically exchanged.

1.3 DEFINITIONS

A. Abbreviation:
   1. Construction Change Directive (CCD).
   2. Change Order (CO).

1.4 BULLETIN

A. Procedures: As indicated herein.

B. If Bulletin is accepted, Construction Manager may issue 1 or more Change Orders for some or all items listed.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Procedures:
   1. Construction Manager to initiate the Construction Change Directive and complete the general information and description of the work portions of the form.
   2. Construction Manager will obtain the Engineer/Architect approval signature and submit to the subcontractor.
   3. Subcontractor to complete the pricing and timing information section of the form, sign and date the form, and return to the Construction Manager.
   4. Construction Manager will sign and date the form, retain an electronic copy for the file and return an electronic copy to the Subcontractor and Engineer.
   5. Upon receipt of the signed Construction Change Directive, Subcontractor is to proceed with the work in a timely manner.
   6. Cost of the work and schedule extensions beyond that stated on the Construction Change Directive require further approval before proceeding.
   7. Within 5 days of completion of the work, Subcontractor shall electronically submit all required documentation for the cost of the Construction Change Directive to the Construction Manager.
   8. Construction Manager will review all pricing documentation and approve or may request additional information.
   9. Upon final pricing agreement, Construction Manager will issue a Change Order to modify the Contract Price and/or schedule to include the Construction Change Directive.
   10. Upon receipt of the final signed Change Order, Subcontractor may invoice for the Construction Change Directive with their next monthly invoice.
   11. If the Construction Change Directive does not modify the Contract Price or schedule, then the Construction Change Directive will be used to document the Construction Change and no Change Order will be written.

1.6 CHANGE ORDER

A. Procedures:
   1. A Change Order is required for any adjustment to the Subcontractor's Contract amount and/or time.
   2. Construction Manager will complete the Change Order form and submit it electronically to the Subcontractor for authorized signature.
   3. Subcontractor is to sign and electronically return it to the Construction Manager.
   4. Construction Manager will sign it, save it electronically in the file and return an electronic copy to the Subcontractor.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01 26 00

SECTION 01 26 13 – REQUESTS FOR INFORMATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedures for Contractor to give notice of conflicts, errors, ambiguities, or discrepancies in the Contract Documents. All documentation shall be electronically exchanged.

1.3 DEFINITIONS

A. Abbreviation: Request for Information (RFI).

1.4 REQUESTS FOR INFORMATION

A. Format:
   1. At Subcontractor's option, generate form or contact Construction Manager for acceptable form.
   2. Minimum required content of Subcontractor's RFI form:
      a. Project name.
      b. Name and address of Subcontractor.
      c. RFI number.
      d. RFI date.
      e. Name of initiator.
      f. Complete written request, with sketches as required.
      g. Signature of initiator.
      h. Space for written response by Construction Manager, signature and date.
      i. Cost impact.
      j. Proposed solution.
      k. Response date required to maintain Construction Schedule.

B. Procedures:
   1. Maintain a log of RFIs, including the RFI date and the date of the response.
   2. Do not submit RFIs for information already included in the Contract Documents.
   3. Changes in Contract Price or Contract Times not permitted within an RFI form.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 26 13

SECTION 01 29 13 – PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes submittal to the Construction Manager of Applications for Payment and supporting documentation as specified herein.

1.3 SUBMITTALS

A. Electronic documentation preferred.

B. Application for Payment: Submit 1 copy on AIA documents G702 and G703 or similar form.

C. Supporting Documentation for Application for Payment:
   1. Subcontractor:
      a. Second and Subsequent Applications for Payment:
         1) Partial Unconditional Waiver sent with previous payment from Construction Manager should be signed and returned.
         2) Sworn Statement listing all sub-subcontractors and vendors. Totals on bottom of Sworn Statement should equal the total of the Subcontractor's contract.
      b. Final Application for Payment:
         1) Final Sworn Statement with Full Unconditional Waiver from each sub-subcontractor or vendor listed on Sworn Statement.
         2) If a bond has been provided: Affidavit and Consent of Surety for final payment provided by bonding Company.
      c. After Final Payment is received, Full Unconditional Waiver sent from Construction Manager with final payment should be signed and returned.
   2. From Suppliers/Vendors:
      a. Second and Subsequent Applications for Payment/Invoice requires Partial Unconditional Waiver which was sent from Construction Manager with previous payment.
      b. After Final Payment is received, Full Unconditional Waiver sent from Construction Manager with final payment should be signed and returned.
   3. From All Laborers/Sub-subcontractors/Suppliers: Construction Manager legally has the right to require that executed partial unconditional waivers be provided whenever they are paid. However, because this would put an undue administrative burden upon Subcontractor and Subcontractor's Sub-subcontractors/Suppliers, Construction Manager is foregoing this right, unless Construction Manager in the future determines that the additional construction lien protection provided by such waivers is merited on this Project.

1.4 COMPLETION OF FORMS

A. General:
   1. All forms must be fully executed.
   2. Sworn Statement Forms:
      a. Include the name and project number as listed on the Project Manual.
      b. Totals at the bottom of the form should equal the total of the Subcontractor's contract.
   3. Partial Unconditional Waiver Forms: Circle "does" or "does not" indicating payment does or does not equal payment for that application less retainage held in accordance with the Contract.

B. Incomplete or incorrect Application for Payment packages will be returned without action.

1.5 FORMS

A. Copies of the forms to be used for the above requirements include the following:
   1. Application and Certificate for Payment (AIA G702 and AIA G703 - not attached).
   2. Sworn Statement (attached).
   3. Partial Unconditional Waiver (attached).
   4. Full Unconditional Waiver (attached).

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

SWORN STATEMENT

State of Michigan)
) ss.
County of _____)

(NAME OF DEPONENT (representative of contractor or subcontractor), being sworn, states the following:

(NAME OF CONTRACTOR OR SUBCONTRACTOR) is the **contractor/subcontractor** for an improvement to the following real property in _____County, Michigan, described as follows:

(insert legal description of property)

The following is a statement of each subcontractor and supplier, and laborer for whom payment of wages or fringe benefits and withholdings is due but unpaid, with whom the **contractor/subcontractor** has **contracted/subcontracted** for performance under the contract with the owner or lessee of the property, and the amounts due to the persons as of the date of this statement are correctly and fully set forth opposite their names:

Name, address and telephone number of subcontractor, Supplier, or laborer	Type of improvement furnished	Total contract price	Amount already paid	Amount currently owing	Balance to complete (optional)	Amount of laborer wager due but unpaid	Amount of laborer fringe benefits and withholdings due but unpaid
TOTALS:							

(Some columns are not applicable to all persons listed)

The contractor has not procured material from, or subcontracted with, any person other than those set forth and owes no money for the improvement other than the sums set forth.

I make this statement as the **(contractor) (subcontractor)** or as _____ of the **(contractor) (subcontractor)** to represent to the owner or lessee of the property and his or her agents that the property is free from claims of construction liens, or the possibility of construction liens, except as specifically set forth in this statement and except for claims of construction liens by laborers that may be provided under section 109 of the construction lien act, 1980 PA497, MCL 570.1109.

WARNING TO OWNER OR LESSEE: AN OWNER OR LESSEE OF THE PROPERTY MAY NOT RELY ON THIS SWORN STATEMENT TO AVOID THE CLAIM OF A SUBCONTRACTOR, SUPPLIER, OR LABORER WHO HAS PROVIDED A NOTICE OF FURNISHING OR A LABORER WHO MAY PROVIDE A NOTICE OF FURNISHING UNDER SECTION 109 OF THE CONSTRUCTION LIEN ACT, 1980 PA 497, MCL 570.1109, TO THE DESIGNEE OR TO THE OWNER OR LESSEE IF THE DESIGNEE IS NOT NAMED OR HAS DIED.

ON RECEIPT OF THIS SWORN STATEMENT, THE OWNER OR LESSEE, OR THE OWNER'S OR LESSEE'S DESIGNEE, MUST GIVE NOTICE OF ITS RECEIPT, EITHER IN WRITING, BY TELEPHONE, OR PERSONALLY, TO EACH SUBCONTRACTOR, SUPPLIER, AND LABORER WHO HAS PROVIDED A NOTICE OF FURNISHING UNDER SECTION 109 OR, IF A NOTICE OF FURNISHING IS EXCUSED UNDER SECTION 108 OR 108A, TO EACH SUBCONTRACTOR, SUPPLIER, AND LABORER NAMED IN THE SWORN STATEMENT. IF A SUBCONTRACTOR, SUPPLIER, OR LABORER WHO HAS PROVIDED A NOTICE OF FURNISHING OR WHO IS NAMED IN THE SWORN STATEMENT MAKES A REQUEST, THE OWNER, LESSEE, OR DESIGNEE SHALL PROVIDE THE REQUESTER A COPY OF THE SWORN STATEMENT WITHIN 10 BUSINESS DAYS AFTER RECEIVING THE REQUEST.

_____
Name of Deponent
(NAME OF CONTRACTOR OR SUBCONTRACTOR)

WARNING TO DEPONENT: A PERSON WHO GIVES A FALSE SWORN STATEMENT WITH INTENT TODEFRAUD IS SUBJECT TO CRIMINAL PENALTIES AS PROVIDED IN SECTION 110 OF THE CONSTRUCTION LIEN ACT, 1980 PA 497, MCL 570.1110.

Subscribed and sworn to before me on this
_____ day of _____ 20___.

_____
Notary Public
_____ County, Michigan
Acting in _____ County
My commission expires: _____

PARTIAL UNCONDITIONAL WAIVER

I/we have a contract with _____
to provide _____ for the improvement to the property described as:

(Put Description of Property Here)

and by signing this waiver waive my/our construction lien to the amount of $___
_____, for labor/materials provided through _____.
(date)

This waiver, together with all previous waivers, if any, (circle one) does / does not cover all amounts due to me/us less retainage held in accordance with the Contract for improvement provided through the date shown above.

If the owner or lessee of the property or the owner's or lessee's designee has received a notice of furnishing from me/one of us or if I/we are not required to provide one, and the owner, lessee, or designee has not received this waiver directly from me/one of us, the owner, lessee, or designee may not rely upon it without contacting me/one of us, either in writing, by telephone, or personally, to verify that it is authentic.

Name of Company
Address
Phone Number

_____
(print name of signer)

_____
(signature)

_____
(signer title)

_____
(date)

DO NOT SIGN BLANK OR INCOMPLETE FORMS. RETAIN A COPY.

FULL UNCONDITIONAL WAIVER

My/our contract with _____
to provide _____ for the improvement of the property described as:

(Put Description of Property Here)

has been fully paid and satisfied. By signing this waiver, all my/our construction lien rights against the described property are waived and released.

If the owner or lessee of the property or the owner's or lessee's designee has received a notice of furnishing from me/one of us or if I/we are not required to provide one, and the owner, lessee, or designee has not received this waiver directly from me/one of us, the owner, lessee, or designee may not rely upon it without contacting me/one of us, either in writing, by telephone, or personally, to verify that it is authentic.

Name of Company
Address
Phone Number

_____
(print name of signer)

_____
(signature)

_____
(signer title)

_____
(date)

DO NOT SIGN BLANK OR INCOMPLETE FORMS. RETAIN A COPY.

END OF SECTION 01 29 13

SECTION 01 29 73 – SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes preparation and submittal of a schedule of values.

1.3 GENERAL

A. Timing of Submittal: Submit to Construction Manager a schedule of values allocated to the various portions of the Work, within 10 days after the Effective Date of the Agreement.

B. Supporting Data: Upon request of Construction Manager, support the values with data which will substantiate their correctness.

C. Use of Schedule: The schedule of values, unless objected to by Construction Manager, shall be used only as the basis for the Subcontractor's Applications for Payment.

1.4 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Form and Identification:
   1. Type schedule on 8-1/2-inch x 11-inch white paper.
   2. Use AIA G703 1992 format or similar form.
   3. Identify Schedule with:
      a. Title of Project and location.
      b. Project number.
      c. Name and address of Subcontractor.
      d. Date of submission.

B. Detail: Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.

C. Subvalues: For each major line item list subvalues of major Products or operations under the item.

D. Change Orders: For each Application for Payment, revise schedule to list each Change Order total as a separate line item.

E. For the various portions of the Work:
   1. Each item shall include a directly proportional amount of Subcontractor's overhead and profit.
   2. For items on which progress payments will be requested for stored materials, break down the value into:
      a. The cost of the materials, delivered and unloaded, with taxes paid.
      b. The total installed value.

F. The sum of all values listed in the schedule shall equal the total Contract Price.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 29 73

SECTION 01 31 19 – PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes scheduling and administering of preconstruction and progress meetings.

B. Scheduling and Administration of Meetings:
   1. Responsibility:
      a. Preconstruction Meeting: Construction Manager.
      b. Progress Meetings: Construction Manager.
   2. Procedures:
      a. Prepare agenda.
      b. Distribute written notice and agendas of meetings 4 days in advance of the meeting date.
      c. Make physical arrangements for the meetings.
      d. Preside at meetings.
      e. Record minutes and include significant proceedings and decisions.
      f. Distribute copies of the minutes within 4 days after meetings to:
         1) Participants.
         2) Others affected by proceedings.

1.3 PRECONSTRUCTION MEETING

A. Schedule: Preconstruction meeting will be scheduled by Construction Manager prior to beginning work on site.

B. Attendance: Representatives of the following parties are to be in attendance at the meeting:
   1. Owner.
   2. Architect/Engineer.
   3. Subcontractor.
   4. Major Subcontractors.
   5. Governmental or regulatory agencies when appropriate.

1.4 PROGRESS MEETINGS

A. Types of Progress Meetings:
   1. Regular.
   2. Called.
   3. Preinstallation

B. Schedule meetings as follows unless otherwise approved by Engineer:
   1. Regular: Bi-weekly.
   2. Called: As the progress of the Work dictates.
   3. Preinstallation: At least 5 working days prior to start of installation.

C. Location: Hold meetings at Project Site/Online or as indicated in the notice.

D. Attendance: Representatives of the following parties are to be in attendance at the meeting:
   1. Architect/Engineer.
   2. Subcontractor.
   3. Major Subcontractors as pertinent to the agenda.
   4. Owner's representative as appropriate.
   5. Governmental or other regulatory agencies as appropriate.

E. Minimum Agenda: The minimum agenda for progress meetings shall consist of the following:
   1. Review and approve minutes of previous meetings.
   2. Review progress of the Work since the previous meeting.
   3. Note field observations, problems and decisions.
   4. Identify problems which impede planned progress.
   5. Review offsite fabrication problems.
   6. Develop corrective measures and procedures to regain plan schedule.
   7. Revise construction schedule as indicated.
   8. Review submittal schedules; expedite as required to maintain schedule.
   9. Maintenance of quality and work standards.
   10. Review changes proposed by Owner for their effect on the construction schedule and completion date.
   11. Identify all claims and potential claims.
   12. Pending changes and substitutions.
   13. Complete other current business.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 31 19

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedures for the submittal of Shop Drawings, Product Data, Samples, Operation and Maintenance Manuals, and other information.

B. Related Sections include pertinent Sections of these Specifications for the individual Submittals required.

1.3 DEFINITIONS

A. Submittal: Information sent by Subcontractor to convey information about systems, equipment, materials, products, and administrative matters for the Work.

B. Resubmittal: Submittal sent for review a second or further time.

C. Product Data: Illustrations, standard schedules, diagrams, performance charts, instructions, brochures, or manufacturer's literature that describe the physical size, appearance, and other characteristics of materials or equipment for a portion of the work.

D. Shop Drawings: All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Subcontractor and submitted by Subcontractor to illustrate some portion of the Work.

E. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

F. Action Submittals: Submittal that requires Engineer's response.

G. Informational Submittals: Submittal that does not require Engineer's response.

H. Delegated-Design: In certain individual Specification Sections, design services or certifications by a design professional are specifically delegated to the Subcontractor. Performance and design criteria are defined in the individual Specification Sections or on the Drawings. Subcontractor is solely responsible for design of those items or systems, coordination of the design with the balance of the Project, and achieving specified performance.

I. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format. All PDF files shall be searchable.

1.4 SUBMITTAL PROCEDURES

A. Submittal Schedule:
   1. A submittal schedule will be provided to each subcontractor. The schedule will include:
      a. Specification Section number.
      b. Submittal description.

B. Delivery Method: Submittals are to be delivered as electronic files except as noted below.
   1. Electronic Files:
      a. Unless indicated otherwise, submit 1 electronic PDF of each Submittal in a format capable of being read using Adobe Acrobat Reader.
      b. Scanned Submittals shall be produced in such a way as to not compromise the graphic quality or accuracy of scale where applicable; text shall be searchable. One electronic copy of each Action Submittal will be returned to Subcontractor.
      c. Submitted electronic documents shall not contain security to limit viewing, editing, or printing.
   2. Web-Based Collaboration and Document Sharing System:
      a. A web-based collaboration and document sharing system may be utilized at Construction Manager's, Owner's, Architect's or Engineer's option.
      b. Use of such a system will be discussed during the preconstruction meeting.
      c. All parties must agree on use of a web-based collaboration and document sharing system.
      d. Training and licensing will be provided for all parties by the party suggesting use of a web-based collaboration and document sharing system.
   3. Transmit Submittals to party and address identified by Construction Manager at preconstruction meeting.

C. Coordination and Timing: Coordinate preparation and processing of Submittals with performance of construction activities. Subcontractor is responsible for cost of delays caused by lack of coordination or tardiness of Submittals. Incomplete Submittals will be rejected.
   1. Coordinate each Submittal with fabrication, purchasing, testing, delivery, other Submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of Submittals for related parts of the Work so processing will not be delayed because of need to review Submittals concurrently for coordination.
      a. Construction Manager reserves the right to withhold action on a Submittal requiring coordination with other Submittals until related Submittals are received.

D. Processing Time: Allow 15 full working days for Construction Manager and Engineer to review each Submittal, including Resubmittals. Time for review shall commence on Construction Manager's receipt of Submittal. No extension of the Contract Time will be authorized because of failure to transmit Submittals enough in advance of the Work to permit processing, including Resubmittals. Construction Manager will advise Subcontractor when a Submittal being processed must be delayed for coordination.

E. Identification: Place a permanent label on each Submittal or generate a separate cover sheet.
   1. Indicate name of firm or entity that prepared Submittal.
   2. Provide space to record Construction Manager's review and approval markings and action taken by Engineer.
   3. Include the following information:
      a. Project name.
      b. Date.
      c. Name and address of Construction Manager.
      d. Name and address of Subcontractor(s).
      e. Name and address of Supplier(s).
      f. Name of Manufacturer.
      g. Submittal number, including revision identifier.
      h. Drawing number and detail references, as applicable.
      i. Location(s) where product is to be installed, as applicable.
      j. Other necessary identification.

F. Deviations: Encircle or otherwise specifically identify deviations from the Contract Documents on Submittals. Submittals that include deviations that are not identified may be rejected. Construction Manager/Engineer may or may not consider deviations.

G. Transmittal: Package each Submittal individually and appropriately for transmittal and handling. Transmit each Submittal using a transmittal form. Construction Manager will reject Submittal(s) received from sources other than Subcontractor.

H. Resubmittals: Make Resubmittals in same form and number of copies as initial Submittal.
   1. Note date and content of previous Submittal.
   2. Clearly identify additions and revisions.
   3. Resubmit Submittals until they are marked, “Reviewed, No Exceptions Noted” or “Reviewed With Corrections Noted.”

I. Distribution: Furnish copies of Submittals with mark indicating, “Reviewed, No Exceptions Noted” or “Reviewed With Corrections Noted,” to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.

J. Use for Construction: Unless otherwise indicated by Construction Manager, use only Submittals with mark indicating, “Reviewed, No Exceptions Noted” or “Reviewed With Corrections Noted.”

1.5 SUBCONTRACTOR'S USE OF ENGINEER’S ELECTRONIC DRAWING FILES

A. At Subcontractor's written request, copies of Engineer’s electronic Drawing files may be provided to Subcontractor for Subcontractor's use in connection with Project, including Submittal preparation. Electronic files may be furnished by Engineer for the convenience of the Subcontractor. Conclusions or information obtained or derived from such electronic files will be at the Subcontractor’s sole risk. Materials furnished by Engineer that may be relied upon are limited to printed Contract Documents.

B. When Subcontractor uses Engineer’s electronic Drawing files to facilitate Submittal preparation, prepare Submittals to be project specific. Submittals that are not project specific, including Engineer’s Drawing files submitted on a new title block, will be rejected.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit project specific Action Submittals required by individual Specification Sections. Do not use highlighting that would not be reproducible. Include a table of contents or index with each Submittal. As part of electronic submittals, the table of contents or index shall include electronic bookmarks to the first page of the respective Section(s) identified.

B. Product Data: Collect information into a single Submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for Submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each Submittal to indicate which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's written recommendations.
      b. Manufacturer's product specifications.
      c. Manufacturer's installation instructions.
      d. Standard color charts.
      e. Manufacturer's catalog cuts.
      f. Wiring diagrams showing factory-installed wiring.
      g. Printed performance curves.
      h. Operational range diagrams.
      i. Mill reports.
      j. Standard product operation and maintenance manuals.
      k. Compliance with specified referenced standards.
      l. Testing by recognized testing agency.
      m. Application of testing agency labels and seals.
      n. Notation of coordination requirements.
   4. Submit Product Data before or concurrent with Samples.
   5. Maintain copy of returned Submittal for Project records.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale where appropriate. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Scale shall be sufficiently large to indicate pertinent features of the item and its method of connection to the Work.
   1. Preparation: Fully illustrate requirements of the Contract Documents. Include the following information, as applicable:
      a. Dimensions.
      b. Identification of products.
      c. Fabrication and installation drawings.
      d. Roughing-in and setting diagrams.
      e. Wiring diagrams showing field-installed wiring, including power, signal, control, and communication wiring. Differentiate between Manufacturer-installed and field-installed wiring.
      f. Manufacturing instructions.
      g. Templates and patterns.
      h. Schedules.
      i. Calculations.
      j. Compliance with specified standards.
      k. Notation of coordination requirements.
      l. Notation of dimensions established by field measurement.
      m. Relationship to adjoining construction clearly indicated.
   2. Maintain copy of returned Submittal for Project records.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed.
   1. Transmit Samples that contain multiple, related components, such as accessories, together in one Submittal package.
   2. Identification: On unexposed side of Samples, attach label that includes the following:
      a. Generic description of Sample.
      b. Product name and name of Manufacturer.
      c. Sample source.
      d. Number and title of appropriate Specification Section.
   3. Disposition: Construction Manager will maintain sets of approved Samples at Site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used by Construction Manager/Engineer to determine final acceptance of construction associated with each set.
      a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples shall be in an undamaged condition at time of Substantial Completion.
      b. Samples not incorporated into the Work, or otherwise designated to become Owner's property, are the property of Subcontractor.
   4. Samples for Initial Selection: Submit Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
      a. Number of Samples: Unless indicated otherwise, submit [2] full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from Manufacturer's product line. Construction Manager will return [1] Submittal with options selected.
   5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, physically identical with material or product proposed for use, and that show full range of color and texture variations expected.
   6. Samples include, but are not limited to, the following: Partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   7. Number of Samples: Unless indicated otherwise, submit 1 set of Samples. Construction Manager will retain a Sample set.
      a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      b. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, 1 set of paired units that show approximate limits of variations.
   8. Maintain returned Sample set for Project records.

E. Operation and Maintenance Manuals:
   1. General:
      a. Where manuals are required to be submitted covering items included in the Work, prepare such manuals in durable plastic binders approximately 8-1/2 inches x 11 inches in size and with at least the following:
         1) Identification on, or readable through, the front cover stating general nature of the manual.
         2) Include a table of contents or index with each Submittal, near the front of the manual. As part of electronic submittals, the table of contents or index shall include electronic bookmarks to the first page of the respective Section(s) identified.
         3) Complete instructions regarding operation and maintenance of all equipment involved, including:
            a) Equipment function, normal operating characteristics, and limiting conditions.
            b) Assembly, installation, alignment, adjustment, and checking instructions.
            c) Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
            d) Maintenance instructions, including lubrication requirements where applicable.
            e) Guide to "troubleshooting".
            f) Parts lists and predicted life of parts subject to wear.
            g) Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams. Wiring diagrams shall reflect final, as-installed conditions and include wire numbers.
            h) Test data and performance curves.
         4) Complete nomenclature of all replaceable parts, their part numbers, current costs, and name and address of nearest vendor of parts.
         5) Copies of all guarantees and warranties issued.
         6) Copies of the reviewed Submittals.
         7) Copies of all data concerning all changes made during construction.
   2. Extraneous Data: Where contents of the manuals include Manufacturer's catalog pages, clearly indicate the precise items included in this installation and delete or otherwise clearly indicate all Manufacturers' data with which this installation is not concerned. Do not use highlighting that would not be reproducible.
   3. Number of Copies Required: Unless otherwise specifically directed by Construction Manager, or stipulated in the pertinent Section of these Specifications:
      a. For review, 1 electronic copy.
      b. For record, submit 4 paper and 1 electronic copies to Construction Manager.
   4. Schedule delivery of record copies of operation and maintenance manuals at least 60 days prior to startup of respective equipment, unless otherwise specified.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by individual Specification Sections. Do not use highlighting that would not be reproducible. Include a table of contents or index with each Submittal. As part of electronic submittals, the table of contents or index shall include electronic bookmarks to the first page of the respective Section(s) identified.

B. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects/engineers and owners, and other information specified.

D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

E. Installer Certificates: Prepare written statements on Manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by Manufacturer for this Project.

F. Manufacturer Certificates: Prepare written statements on Manufacturer's letterhead certifying that Manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

G. Product Certificates: Prepare written statements on Manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

H. Material Certificates: Prepare written statements on Manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

J. Product Test Reports: Prepare written reports indicating current product produced by Manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by Manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   1. Name of evaluation organization.
   2. Date of evaluation.
   3. Time period when report is in effect.
   4. Product and manufacturers' names.
   5. Description of product.
   6. Test procedures and results.
   7. Limitations of use.

L. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

M. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

N. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

O. Manufacturer's Instructions: Prepare written or published information that documents Manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of Manufacturer. Include the following, as applicable:
   1. Preparation of substrates.
   2. Required substrate tolerances.
   3. Sequence of installation or erection.
   4. Required installation tolerances.
   5. Required adjustments.
   6. Recommendations for cleaning and protection.

P. Manufacturer's Field Reports: Prepare written information documenting tests and inspections of factory-authorized service representative. Include the following, as applicable:
   1. Name, address, and telephone number of factory-authorized service representative making report.
   2. Statement of substrate condition and acceptability of substrate for installation or application of product.
   3. Statement that products at Site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Document all settings in writing.
8. Other required items indicated in individual Specification Sections.

Q. Safety Data Sheets (SDSs): Submit information separately directly to Construction Manager.
1. Submit 1 paper copy of SDSs and only for products that will be used at the Site.
2. Divide products into CSI divisions.
3. SDS's not submitted in this format will be rejected and returned for resubmittal.

2.3 DELEGATED-DESIGN SUBMITTALS

A. Where design services or certifications by a design professional are specifically required of Subcontractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated, which Subcontractor has coordinated with the balance of the Project.

B. Performance type design documents and calculations shall be prepared by a design professional as required by the individual Specification Section, licensed in the [State] [jurisdiction] where the Project is being constructed. Design shall be signed and sealed by the responsible design professional. Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Identify name and version of software, if any, used for calculations.

C. In addition to Shop Drawings, Product Data, and other required Submittals, submit 3 copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Subcontractor to be designed or certified by a design professional. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 SUBCONTRACTOR'S REVIEW

A. Review each Submittal and check for coordination with other work of the Contract and for compliance with the Contract Documents. Verify all field dimensions and conditions; note corrections as necessary. Mark with approval stamp before submitting to Construction Manager.
1. Approval Stamp: Stamp each Submittal with an approval stamp. Use the same stamp format for each Submittal. Include Project name and location, Submittal number, Specification Section title and number, name of reviewer, date of Subcontractor's approval, and statement certifying that Submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

B. Submittals that are not approved and stamped by Subcontractor will be rejected.

3.2 CONSTRUCTION MANAGER/ENGINEER'S REVIEW

A. Action Submittals: Construction Manager/Engineer will review Action Submittals, make marks to indicate corrections or modifications required, and return Submittal. Construction Manager/Engineer will stamp each Submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
1. Reviewed, No Exceptions Noted: Submittal appears to conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Reviewed With Corrections Noted: Upon incorporation of review comments, it appears that Submittal will conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

3. Revise and Resubmit: Submittal has one or more specific segments that are incomplete, do not appear to conform to the information given in the Contract Documents, or are incompatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Subcontractor shall resubmit information for review to demonstrate understanding of comments and portions of Work to be provided. Except as noted, Subcontractor shall not proceed with Work related to Submittal.
4. Rejected, Resubmit: Submittal as a whole is incomplete, does not appear to conform to the information given in the Contract Documents, or is incompatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Subcontractor shall resubmit information for review to demonstrate understanding of comments and portions of Work to be provided. Subcontractor shall not proceed with Work related to Submittal.
5. Received for Record: Submittal for closeout document appears to conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Submittal will not be returned to the Subcontractor without a specific request. The Submittal has been accepted as a record document.

B. Informational Submittals: Other Submittals required by the Contract Documents are for information only. Construction Manager/Engineer will acknowledge receipt of Informational Submittals. Such Submittals include, but are not limited to:
1. Qualifications Data.
2. Certificates.
3. Test Reports.
4. Manufacturer's Instructions.
5. Maintenance Data.
6. Field Reports.

C. Delegated-Design Submittals: Review of Delegated-Design Submittals by Construction Manager/Engineer shall not relieve Subcontractor of Subcontractor's sole responsibility for design and achieving specified performance.

D. Submittals not required by the Contract Documents will be returned without being reviewed.

E. Partial Submittals are not acceptable, will be considered non-responsive, and will be rejected.

3.3 RE-REVIEW COSTS

A. Compensation:
1. Should Construction Manager/Engineer be required to review a Submittal more than twice because of failure of the Submittal to meet the requirements of the Contract Documents, Construction Manager/Engineer will record their expenses for performing all additional reviews.
2. Subcontractor will compensate Construction Manager/Engineer for these additional services and deduct the amount paid from payments to Subcontractor.

END OF SECTION 01 33 00

SECTION 01 45 34 – SPECIAL INSPECTIONS AND TESTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes provisions for special inspections and includes the Statement of Special Inspections.
   1. Special inspections of structures.
   2. Special inspections within structures.
   3. Special inspections of underground components within 5-feet outside of the footprints of structures.

B. Special inspection services for which Owner will contract and pay directly and will be performed by a special inspector or inspectors selected by Construction Manager:
   1. Steel construction.
   2. Concrete construction.
   3. Soils.
   4. Driven deep foundations.
   5. Helical pile foundations.
   6. Sprayed fire-resistant materials.
   7. Travel expense of the special inspector.

C. Include the following testing, special inspections and certifications in the Subcontractor’s Base Bid:
   1. Inspections and tests required by codes or ordinances or by an authority having jurisdiction and made by a legally constituted authority.
   2. Inspections, testing services and certifications including, but not limited to, the following:
      a. Pipe leakage tests.
      b. Pile load tests and test piles.
      c. Welder certifications.
      d. Structural steel yield strength mill tests.
      e. Pipe material yield strength tests.
      f. Manufacturer’s certificate of compliance for high-strength bolts.
      g. Manufacturer’s certificate of compliance for weld filler metal.
      h. Manufacturers' certification tests for cement.
      i. Supplier’s certification tests for fine and coarse aggregate.
      j. Aggregate alkali reactivity testing.
      k. Supplier’s certification tests for bedding material.
      l. Manufacturer’s certified test reports of material, yield strength and gage for cold-formed steel deck and cold-formed metal framing.
      m. Testing in connection with the Construction Manager's review of materials and equipment proposed by Subcontractor to be incorporated into the Work.
      n. Testing performed for the Subcontractor's convenience.

D. Special Inspection of Load-Bearing Fabrications:
   1. Fabricators: Registered and approved in accordance with the Building Code so that special inspection of the fabrication of Project load-bearing components on the fabricator’s premises will not be required.

E. Owner Paid Items: Owner may elect to inspect or to employ either Engineer or a special inspector to inspect materials or systems on the Project other than those specified herein. The cost of this inspection will be paid for by Owner.

F. Special inspection services are required to verify compliance with the Contract Documents and with the requirements of the Building Code. These services do not relieve Subcontractor of responsibility for verification of compliance with Contract Document requirements.

1.2 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ACI - American Concrete Institute:
      a. 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
      b. 301 - Specification for Structural Concrete.
      c. 318 - Building Code Requirements for Reinforced Concrete.
   2. AISC:
      a. 360 - Specification for Structural Steel Buildings.
   3. ASTM Standards:
      a. C31 - Practice for Making and Curing Concrete Test Specimens in the Field.
      b. C33 - Specification for Concrete Aggregates Including Appendix XI.
      c. C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      d. C42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
      e. C138 - Test Method for Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete.
      f. C140 - Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
      g. C143 - Test Method for Slump of Hydraulic-Cement Concrete.
      h. C157 - Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
      i. C172 - Practice for Sampling Freshly Mixed Concrete.
      j. C173 - Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
      k. C192 - Practice for Making and Curing Concrete Test Specimens in the Laboratory.
      l. C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
      m. C295 - Guide for Petrographic Examination of Aggregates for Concrete.
      n. C1019 - Test Method for Sampling and Testing Grout.
      o. D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
      p. D1556 - Test Method for Density and Unit Weight of Soil In Place by Sand-Cone Method.
      q. D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
      r. D1586 - Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.
      s. D2166 - Test Method for Unconfined Compressive Strength of Cohesive Soil.
      t. D2167 - Test Method for Density and Unit Weight of Soil In Place by the Rubber Balloon Method.
      u. D2937 - Test Method for Density of Soil in Place by Drive-Cylinder Method.
      v. D6938 - Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
   4. AWS:
      a. D1.1 - Structural Welding Code - Steel.
      b. D1.3 - Structural Welding Code - Sheet Steel.
   5. Michigan Building Code.
   6. RCSC - Research Council on Structural Connections: Specification for Structural Joints Using High-Strength Bolts.
   7. SDI - Steel Deck Institute: QA/QC – Quality Control and Quality Assurance for Installation of Steel Deck.
   8. MDOT:
      a. Standard Specifications for Construction.
      b. Density Testing and Inspection Manual.

1.3 DEFINITIONS

A. Terms:
   1. Building Code: The building code plus amendments, if any, legally adopted for the location in which the Project is located.
   2. Special Inspection: Inspection and testing as herein required of materials, installation, fabrication, erection or placement of components and connections requiring special expertise of one or more approved special inspectors in order to ensure compliance with the Building Code and the Contract Documents.
   3. Testing Agency; Independent Testing Agency: Special inspector.

1.4 PERFORMANCE REQUIREMENTS

A. Special Inspector Qualifications:
   1. Qualified in accordance with the Building Code and by local building official.
   2. Objective, competent and independent from the Subcontractor performing the work to be inspected.
   3. Familiar with Building Code requirements for special inspections.
   4. Having adequate equipment, periodically calibrated as required, to perform the special inspections.
   5. Employing experienced personnel educated in conducting, supervising and evaluating special inspections similar in complexity to that required for the Project.
   6. Weld Inspectors: Certified in accordance with AWS D1.1, D1.3, D1.4 and D1.8, as applicable.
   7. Submission of Qualifications:
      a. Special Inspector: Provide written documentation to the building official as required, to demonstrate competence, objectivity and experience or training.
      b. Disclose possible conflicts of interest.

B. Perform special inspections in accordance with:
   1. Laws and Regulations.
   2. Reference procedures and requirements.
   3. Building Code.
   4. Contract Documents.
   5. Manufacturer's requirements, as applicable.
   6. Reviewed submittals for the Project, as applicable.

C. Testing Outside a Structure Footprint: In accordance with Division 01 Section "Testing for Buried Utilities, Roadways, and Site Projects."

1.5 REINSPECTION COSTS

A. Reinspection:
   1. When initial special inspections of items except soil compaction indicate noncompliance with the Contract Documents, subsequent special inspections occasioned by the noncompliance shall be performed by the same special inspection agency, and the costs thereof will be deducted by the Construction Manager from the Contract Sum.
   2. Soil Compaction:
      a. The first retesting of soil compaction shall be paid for in accordance with the provisions of the Contract Documents.
      b. The second and subsequent retesting for soil compaction due to noncompliance with the Contract Documents shall be performed by the same special inspection agency, and the costs thereof will be deducted by the Construction Manager from the Contract Sum.

B. Uncovering Costs: Paid for as described in the Agreement.

1.6 REPORTS AND SUBMISSIONS

A. Special Inspection Reports:
   1. Special Inspector: Keep records of special inspections in accordance with the Building Code.
   2. Records: Indicate that work inspected was or was not completed in conformance with the Contract Documents.
   3. Report and reinspect non-conformances until they are in conformance with the Contract Documents.
   4. Final Report:
      a. Prepare and submit a final report at the completion of the special inspections.
      b. Document the completion of specified special inspections and correction of discrepancies.
      c. Submit as specified for inspection reports.
   5. Provide typed electronic copies of reports to:
      a. Construction Manager.
      b. Engineer.
      c. Subcontractor.
      d. Building official.
   6. Discrepancies: Bring to immediate attention of Subcontractor, and, if not corrected, to attention of Construction Manager and building official.

1.7 SCHEDULES FOR SPECIAL INSPECTIONS

A. Establishing Schedule: By advance discussion between special inspector, Construction Manager and Subcontractor, determine the time required to perform special inspection and to issue findings.

B. Revising Schedule: When changes of construction schedule are necessary during construction, coordinate such changes of schedule with the special inspector.

C. Adherence to Schedule: When the special inspector is ready according to the determined schedule, but is prevented from performing special inspection due to incompleteness of the Work, extra costs attributable to the delay may be charged to Subcontractor and shall not be borne by Construction Manager.

1.8 SUBCONTRACTOR'S DUTIES

A. Cooperate with Special Inspector:
   1. Schedule the Work so that special inspector is allowed a reasonable schedule and amount of time to access and view the components requiring special inspection before being obscured by subsequent construction.
   2. Notify Construction Manager and special inspector 24 hours minimum prior to expected time when special inspection services will be required.
   3. Provide the following as necessary for special inspector to properly perform its functions:
      a. Access to the Work.
      b. Facilities for access to the Work.
      c. Tools.
      d. Storage.
      e. Assistance as requested.

B. Submission of Written Statements:
   1. To be submitted by each Subcontractor responsible for construction of a main wind or seismic force resisting system, designated seismic system or a wind or seismic resisting component listed in the Statement of Special Inspections.
      a. Submit to Special Inspector, building official, Owner, and Construction Manager, prior to commencement of construction on the respective system or component.
      b. Acknowledging awareness of the special inspections specified herein.
   2. Each fabricator, at the completion of their respective fabrication, shall submit a certificate of compliance to the building official and Construction Manager stating that the fabrication was performed in accordance with the Contract Documents.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 STATEMENT OF SPECIAL INSPECTIONS

A. Frequency of Special Inspections:
   1. The minimum frequency of the special inspections (periodic vs. continuous) shall be as indicated in the Building Code.

B. Steel Construction:
   1. Inspect and verify structural steel in accordance with the quality assurance requirements of AISC 360 and the Contract Documents.
   2. Steel Construction Other Than Structural Steel:
      a. Inspect and verify cold formed steel floor and roof deck in accordance with the quality assurance inspection requirements of SDI QA/QC.

b. Cold-Formed Metal Framing:
   1) Inspect load bearing members and connections.
   2) Verify member sizes and connection configurations conform to the Contract Documents and reviewed submittals.
   3) Verify that screwed connections are not stripped, and members are pulled into firm contact.

C. Concrete Construction:
1. Special Inspections:
   a. Except for material testing, perform special inspections in accordance with Table 1705.3 of the Building Code and this Specification for all concrete.
   a. Inspect and verify:
      1) Reinforcing steel and placement.
      2) Anchor rods prior to and during placing of concrete.
      3) Anchors post-installed in hardened concrete.
      4) Proper use of required design mix.
      5) Proper placement of concrete.
      6) Maintenance of specified curing techniques and temperatures.
      7) Erection of precast concrete members.
      8) Concrete formwork for proper shape, location and dimension.
2. Material Testing:
   a. Perform material testing for all concrete.
   b. Point of sampling and the method of securing the Samples:
      1) Determined by special inspector.
      2) In accordance with ASTM C172.
   c. Slump Tests:
      1) Perform slump tests in accordance with ASTM C143.
      2) Perform one slump test on the Site for each 30 cubic yards of concrete.
      3) At Construction Manager's request, also perform slump tests at batch plant before adding water reducer.
      4) Perform more slump tests if deemed necessary by Construction Manager.
   d. Perform 1 air-entraining test in accordance with ASTM C231 or C173 for each truckload or every 10 yards of concrete placed, whichever is more frequent.
   e. Test the concrete unit weight in accordance with ASTM C138 or C567, as applicable.
   f. Test the air content and fresh concrete temperature of each set of concrete cylinders.
   g. Concrete Cylinder Testing:
      1) In accordance with ASTM C31 and C39.
      2) Take concrete cylinder Samples as follows:
         a) Once each day a given class of concrete is placed, nor less than
         b) Once for each 150 cubic yards (or fraction thereof) of each class of concrete placed each day, nor less than
         c) Once for each 5,000 square feet of slab or wall surface area placed each day.
      3) Concrete cylinder Sample shall consist of a minimum of 4 cylinders.
         a) Make standard 6x12 cylinders, except that for concrete mixes with 1-inch or smaller coarse aggregate, 4x8 cylinders may be used.
         b) Subcontractor shall be responsible for having additional pairs of cylinders taken and tested, if required to demonstrate adequate concrete strengths at ages earlier than 28 days if Subcontractor’s schedule requires form removal from load-bearing concrete prior to 28 days.
      4) Handle cylinders carefully.
      5) On Site Storage:
         a) 12 hours, minimum, 48 hours maximum.
         b) At a temperature range of 60 to 80 degrees F and in a moist environment.
         c) Shielded from direct sunlight and radiant heat.
         d) The Subcontractor shall construct heated or water bath enclosures, as applicable, if conditions require.
         e) Cylinder Samples taken to establish adequate strength for form removal earlier than 28-days shall be cured in locations that represent the conditions under which the structural concrete will be cured.

6) Laboratory Curing:
   a) For duration of curing after on Site storage.
   b) Does not include cylinders taken to establish adequate strength for form removal earlier than 28-days.
7) Test 1 of the cylinders at 7 days and 2 cylinders at 28 days. Save 1 cylinder as a spare.
8) Acceptance and evaluation of the concrete shall be based on ACI 301.

3. Concrete Slab Flatness and Levelness Testing:
   a. Determine F-numbers of test slabs, if applicable, and production floors where flatness and levelness have been specified using F-numbers.
   b. Special inspector shall monitor floor slab installation and assist in developing procedures necessary to satisfy specified flatness and levelness.
   c. Construction of floor slabs shall not begin until Contractor has demonstrated Contractor's ability in test slab area to routinely satisfy specified flatness and levelness.

D. Soils:
1. Inspect and verify in accordance with Table 1705.6 of the Building Code and this Specification.
2. Inspect and verify:
   a. Soil Below Shallow Foundations:
      1) Verify materials and compaction are suitable to support the structures at the design soil bearing value indicated on the Drawings with acceptable anticipated settlement.
   b. Excavations are extended to proper depth and reached proper material.
   c. Classification of structure fill and backfill material.
   d. Classification of utility backfill material.
   e. Use of proper fill and backfill materials, lift thicknesses and compaction.
   f. Prior to placement of fill, subgrade material and preparation, and subgrade compaction.
   g. Proof-Rolling:
      1) Witness proof-rolling of exposed subgrade of structure footprint .
         a) Subcontractor shall provide heavy rubber tired truck and labor for proof-rolling.
      2) Report to Construction Manager and Subcontractor areas of subgrade requiring compaction or replacement.
   h. Minimum Frequency of Soil Compaction Verification:
      1) Within Footprint of Structures:
         a) One test per 1,000 square feet of subgrade for each layer of fill.
         b) One test per 50 feet of utility trench for each layer of fill.
   i. Perform more frequent testing when necessary because of Site conditions and approved by Construction Manager.

E. Driven Deep Foundations:
1. Inspect and verify in accordance with Table 1705.7 of the Building Code and the Contract Documents.
2. Inspect and verify:
   a. Pile element materials, sizes and lengths for conformance to the Contract Documents.
   b. Pile load tests and pile tests performed by Subcontractor.
   c. Driving operations.
   d. Pile placement, location and plumbness; hammer size, type and capacity; number of blows per foot of penetration; required penetration to achieve design capacity and actual achieved; tip and butt elevations relative to a Site permanent datum; and observed damage.
   e. Perform special inspections of steel elements of driven deep foundations as indicated in this specification Section for Steel Construction.
   f. Perform special inspections of concrete and concrete filled elements of driven deep foundations as indicated in this specification Section for Concrete Construction.
3. Special inspector shall maintain records of the above for each element.

F. Helical Foundations:
1. Inspect and verify:
   a. Installation equipment used.
   b. Pile dimensions.
   c. Pile placement, location and plumbness; final installation torque; and actual tip elevation relative to a Site permanent datum.
2. Special inspector shall maintain records of the above for each element.

END OF SECTION 01 45 34

SECTION 01 45 35 – TESTING SERVICES FOR BURIED UTILITIES, ROADWAYS, AND SITE PROJECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes testing services as follows:
   1. Testing services which will be contracted and paid for directly by the Owner and performed by an independent testing agency selected by the Engineer or the Owner:
      a. Fill material from onsite and offsite.
      b. Fine and coarse aggregate certification tests.
      c. Bedding material certification tests.
      d. Bituminous pavement materials.
      e. Laboratory soil proctor tests.
      f. Soil compaction tests.
      g. Verification of soil bearing capacity.
      h. Base and subbase compaction tests.
      i. Pavement compaction tests.
      j. Collecting and transporting soil samples to the independent testing agency's laboratory.
      k. Laboratory soil proctor tests.
      l. Concrete slump and air entrainment tests.
      m. Concrete cylinder compressive strength tests.
      n. Travel expense of the independent testing agency.
      o. Making concrete cylinders.
      p. Transporting cylinders to testing agency's laboratory and performing tests.
   2. Testing services and certifications which will not be contracted and paid for directly by Owner and should be included in the Contractor’s base Bid:
      a. Pipe leakage and pressure tests.
      b. Pipe material tests.
      c. Testing performed for the Contractor's convenience.
   3. Owner Paid Items:
      a. The Owner may elect to inspect or test or to employ either the Engineer or an independent testing agency to test materials on the Project other than those specified herein.
      b. The cost of this testing will be paid for by the Owner.

B. Testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for verification of compliance with Contract Document requirements.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. AASHTO:
      a. Provisional Standard – TP 23 Standard Test Method for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.
   2. ASTM Specifications, Tests and Test Methods:
      a. C31 – Making and Curing Concrete Test Specimens in the Field.
      b. C33 – Specification for Concrete Aggregates Including Appendix XI.
      c. C39 – Test for Compressive Strength of Cylindrical Concrete Specimens.
      d. C42 – Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
      e. C138 – Test for Unit Weight, Yield and Air Content of Concrete.
      f. C143 – Test for Slump of Portland Cement Concrete.
      g. C172 – Sampling Fresh Concrete.

h. C173 – Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
i. C192 – Making and Curing Concrete Test Specimens in the Laboratory.
j. C227 – Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
k. C231 – Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
l. C289 – Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
m. C295 – Standard Guide for Petrographic Examination of Aggregates for Concrete.
n. C567 – Unit Weight of Structural Lightweight Concrete.
o. C1077 – Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
p. D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort.
q. D1188 – Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.
r. D1556 – Density of Soil In Place by the Sand-Cone Method.
s. D1557 – Moisture-Density Relations of Soils and Soils Aggregate Mixture Using 10 Pound Rammer and 18-Inch Drop.
t. D1586 – Penetration Test and Split Barrel Sampling of Soils.
u. D1883 – CBR (California Bearing Ratio) of Laboratory Compacted Soils.
v. D2166 – Unconfined Compressive Strength of Cohesive Soil.
w. D2167 – Density of Unit Weight of Soil In Place by the Rubber Balloon Method.
x. D2922 – Density of Soil and Soil Aggregates by Nuclear Methods.
y. D2937 – Density of Soil in Place by Drive Cylinder Method.
z. D2950 – Test Methods for Density of Bituminous Concrete in Place by Nuclear Methods.
aa. D3666 – Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.
bb. D3740 – Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction.

3. ACI – American Concrete Institute:
   a. 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
   b. 211.1R – Report on Alkali-Aggregate Reactivity.
   c. 301 – Specification for Structural Concrete for Buildings.
   d. 318 – Building Code Requirements for Reinforced Concrete.
4. MDOT Standards: Michigan Cone Test for Determination of Maximum Unit Weight of Granular Soils.

1.4 TEST REQUIREMENTS

A. In accordance with:
   1. Laws and Regulations.
   2. Sections of these Specifications.
   3. Reference procedures and requirements.
   4. Pertinent standards for testing.

B. Testing Agency Qualifications:
   1. Approved by authorities having jurisdiction.
   2. Agency whose primary business is materials and construction testing.
   3. Approved by the Engineer or the Owner.
   4. Objective, competent and independent from the Contractor performing the work to be inspected.
   5. Having adequate equipment, periodically calibrated as required, to perform the special inspections.
   6. Employing experienced personnel educated in conducting, supervising and evaluating special inspections similar in complexity to that required for the Project.

1.5 RETESTING COSTS

A. Retesting:
   1. When initial special inspections of items except soil compaction indicate noncompliance with the Contract Documents, subsequent special inspections occasioned by the noncompliance shall be performed by the same special inspection agency, and the costs thereof will not be reimbursed.

2. Soil Compaction:
   a. The first retesting of soil compaction shall be paid for in accordance with the provisions of the Contract Documents.
   b. The second and subsequent retesting for soil compaction due to noncompliance with the Contract Documents shall be performed by the same special inspection agency, and the costs thereof will not be reimbursed.

1.6 REPORTS

A. Provide the Engineer's field representative and Contractor's superintendent with a draft copy of the daily report prior to leaving the Project Site each day on which testing is performed on the Site.

B. Provide typed copies of testing agency reports, inspections, and certifications within 5 business days to:
   1. The Engineer's Office: One copy.
   2. The Contractor's Office: One copy.

1.7 SCHEDULING TESTING

A. Coordinate and schedule the work of the independent testing agency.
   1. Notify the Engineer and the independent testing agency 48 hours prior to the expected time when testing services will be required.
   2. Provide access to the Work as necessary for the agency to properly perform its functions.

B. Establishing Schedule: By advance discussion with the Engineer and independent testing agency, determine the time required to perform tests and to issue findings.

C. Revising Schedule: When changes of construction schedule are necessary during construction, coordinate all such changes with the independent testing agency as required.

D. Adherence to Schedule: When the independent testing agency is ready to test according to the determined schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra costs for testing attributable to the delay will be paid by the Contractor.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TESTING REQUIREMENTS

A. Fine and Coarse Aggregate and Bedding Material:
   1. Sieve test to ensure compliance with the materials specifications.
   2. Provide 1 test for each source of imported materials as directed by the Engineer.

B. Fill Material from Onsite and Offsite Sources: Sieve test to ensure compliance with the materials specifications.

C. Soil Compaction:
   1. Minimum Frequency of Testing:
      a. Within the Building Footprint: See Division 01 Section "Special Inspections and Tests."
      b. Outside a Building Footprint: One test per 5,000 square feet of subgrade for each layer of fill.
      c. Utility Trenches: One test for every 200 linear feet of trench length at each lift.
      d. Utility Structures: One test under each manhole, vault or other structure.
      e. Curb and Gutter: One test for every 100 linear feet.
      f. Pavement Subgrade, Base Grade:
         1) One test for every 2,500 square feet for road construction.
         2) One test at every driveway or curb cut location.
         3) One test for every 500 square feet for road intersections.

2. Predominately Granular Soils:
   a. Perform necessary laboratory and field testing required to verify compaction of fill, bedding, trench backfill and structure backfill in accordance with ASTM D1557 or Michigan Cone.
   b. Verify the compaction of the first 12 inches of the existing subgrade below structures, utility structures, paved areas, and areas to be filled in accordance with ASTM D1557 or Michigan Cone.
3. Predominately Cohesive Soils:
   a. Perform necessary laboratory and field testing required to verify compaction of fill trench backfill and structure backfill in accordance with ASTM D698.
   b. Verify the compaction of the first 12 inches of the existing subgrade below structures, utility structures, paved areas, and areas to be filled in accordance with ASTM D698.
4. Independent testing agency shall inform the Engineer and the Contractor's onsite supervisor immediately of onsite test results.
5. Place no additional fill in areas where compaction results do not meet Specification requirements.

D. Testing Bituminous Paving:
1. The testing agency shall provide quality control and testing services that will be monitored by the Engineer's field representatives continuously during paving.
2. The testing agency shall take 1 mixture sample per day and 1 test per 1,000 tons of material placed.
   a. This sample shall be taken randomly from the back of the hauling unit.
   b. This sample shall be large enough to provide the Contractor, testing agency, and Engineer with an equal split of the sample.
   c. The testing agency shall test the samples for the following:
      1) 50 blow Marshall bulk specific gravity or a 50 gyration gyratory compactor bulk specific gravity (G_{mb}).
      2) Theoretical Maximum Density (TMD) (AASHTO T209) or maximum specific gravity of paving mixture (no air voids) (G_{mm}).
      3) % Asphalt binder.
      4) Aggregate gradation and % crushed aggregate.
   d. With the above information and the mix design aggregate effective specific gravity, calculate the following:
      1) Mixture air voids.
      2) Mixture voids in the mineral aggregate (VMA) using bulk specific gravity of aggregate (Gsb).
      3) % Asphalt binder.
3. The results of these tests shall be compared to the approved mix design and must be within the tolerances indicated below or all additional truck loads of non-compliant material shall be removed from the Site.
   a. The material supplier shall then make recommendations to the Engineer of how the mixture will be revised to meet the Specifications.
   b. The results of these tests and the split samples must be presented to the Engineer before mixture production begins the following day.
   c. If the Engineer wishes to test the split samples, they may use the supplier's laboratory and equipment.
   d. The Engineer reserves the right to work with the supplier and modify the supplier's mix design to ensure the product meets the Drawings and Specification requirements.
   e. This may include increasing asphalt content and adjusting aggregate gradations within the bituminous mixture composition specification.

Testing/Verification Tolerances			
Parameter	Single test	Average of 2 or more tests	Comments
Air Voids	±1.00%	-1.0%+0.5%	
VMA	±1.20%	±1.20%	
TMD (G_{mm})	±0.019	±0.015	
Asphalt Binder	±0.4%	±0.3%	>0.4% less than JMF may be subject to reduced payment
%Fines/% Asphalt	Max 1.6	Max 1.6	Result must be less than 1.6
#4 sieve	±5.0%	±3.0%	
#30 sieve	±4.0%	±3.0%	
#200 sieve	2.0%	±1.0%	
Crushed Particles	±10%	±10%	>10% less than JMF may be subject to reduced payment

4. The Contractor shall have the testing agency's density technician and a density gage available whenever paving is occurring. This technician and gage shall monitor placement and compaction of asphalt to verify the maximum density possible is being achieved.
5. Density gage readings shall be taken at core locations prior to coring.
6. The testing agency shall take 1 core on each 25,000 square feet of new parking lot.
    a. The percent compaction of these cores shall be calculated using the TMD of the approved mix design (JMF) unless otherwise directed and the results used for determining compliance with this Specification.
    b. The daily average in place density:
        1) Low/medium Volume Roads: 95.0% of the mixture's TMD or greater with a minimum density of 94% of TMD.
        2) Heavy Volume Roads: 94% of the mixtures TMD or greater with a minimum density of 93% TMD.
    c. Areas that are not compacted to the specified daily average will be evaluated by the Engineer and may either be removed or subject to a price reduction.
7. Thickness: In place compacted thickness tested in accordance with ASTM D3549.
8. Surface Smoothness:
    a. Test finished surface of each hot mix asphalt course for smoothness, using 10 foot straightedge applied parallel with and at right angles to centerline of paved area, or by measuring depths of bird baths immediately after a rain.
9. Workmanship:
    a. Finished Surfaces, Especially in High Visibility Areas: Smooth, free of cracks, raveling or spalling holes, rake or roller marks and depressions, or bird baths.
    b. Problem Areas Identified: Correct by removing, paving or reheating and re-rolling if possible.
10. Test Reports:
    a. Summarize the results of the bituminous paving using the "Report of Verification/Acceptance Testing & Core Density."
    b. Electronically submit this document to the Project team on a daily basis prior to the placement of any subsequent pavement.
11. Porous Bituminous Asphalt.
    a. Mix Verification (ASTM D2172): One test per 1,000 ton placed or fraction thereof.
    b. Weight Slips:
        1) Furnish weight slips for material incorporated in the Project.
        2) Verify that the required tonnage has been applied by calculating and submitting yield for each day of work.
    c. Compaction and Thickness Testing:
        1) Nuclear Gage (ASTM D2950): Minimum 5 per day or 1 test per 7,500 square feet.
        2) Pavement Cores: Minimum 2 per day or 1 test per 20,000 square feet or as directed.
    d. Field Infiltration Test:
        1) In accordance with ASTM C1701.
        2) One test per 25,000 square feet.
        3) Witnessed by Engineer.
    e. Surface Smoothness: Test using a 10 foot straightedge applied parallel to and at right angles with the centerline.

E. Concrete Testing:
1. Point of sampling and the method of securing the Samples:
    a. Determined by the independent testing agency.
    b. In accordance with ASTM C172.
2. Slump Tests:
    a. Perform slump tests in accordance with ASTM C143.
    b. Perform 1 slump test on the Site for each truckload of concrete.
    c. At the Engineer's request, also perform slump tests at batch plant before adding water reducer.
    d. Perform more slump tests if deemed necessary by the Engineer.
3. Perform 1 air-entraining test in accordance with ASTM C231 or C173 for each truckload of concrete.
4. Test the concrete unit weight in accordance with ASTM C138 or C567, as applicable.
5. Test the air content and fresh concrete temperature of each set of concrete cylinders.
6. Concrete Cylinder Testing:
    a. In accordance with ASTM C31 and C39.

b. Take concrete cylinder Sample set as follows:
   1) Once for each 150 cubic yards (or fraction thereof) of each class of concrete placed each day, nor less than.
   2) Once for each 2,500 square feet of sidewalk or paving surface area placed each day.
c. Concrete Cylinder Sample Set: Consist of 4 standard 6-inch cylinders.
d. Handle cylinders carefully.
e. Onsite Storage:
   1) Handle cylinders carefully.
   2) 12 hours, minimum, 48 hours maximum.
   3) Store at a temperature range of 60 to 80 degrees F and in a moist environment.
   4) Shield from direct sunlight and radiant heat.
   5) Construct heated or water bath enclosures, as applicable, if conditions require.
   6) Cylinder samples taken to establish adequate strength for form removal earlier than 28 days shall be cured in locations that represent the conditions under which the structural concrete will be cured.
f. Laboratory Curing: For duration of curing after onsite storage.
g. Test 1 of the cylinders at 7 days and 2 cylinders at 28 days. Save 1 cylinder as a spare.
h. Acceptance and evaluation of the concrete shall be based on ACI 301.

7. Porous Concrete:
   a. Testing Frequency: Each 150 yd^3 or fraction thereof; minimum 1 set of tests for each day placement.
   b. Field Testing:
      1) Sampling: Plastic concrete in accordance with ASTM C172.
      2) Density:
         a) ASTM C1688/C1688M.
         b) Acceptance – within 5 lb/ft^3 of approved design density (unit weight).
      3) Void Content:
         a) Plastic concrete in accordance with ASTM C1688/C1688M.
         b) Acceptance: Not more than 2% below the specified minimum.
   c. Concrete Cores:
      1) Construct a test panel for each day of production.
         a) Use same materials and procedures as production paving.
         b) Minimum size 5 foot x 5 foot.
      2) Up to 3 cores for each day's production or each 150 yd^3 or fraction thereof or as directed.
      3) In accordance with ASTM C42.
      4) After minimum of 7 days analyze 1 core from the set.
         a) Thickness:
            (1) ASTM C174.
            (2) Acceptance: Untrimmed samples not less than 1/2 inch specified thickness.
         b) Void Content:
            (1) ASTM C642.
            (2) A New Test Method for Porosity Measurements of Portland Cement Pervious Concrete *Felipe Montes,*1 *Srinivas Valavala,*1 *and Liv M. Haselbach*2; *Journal of ASTM International*, January 2005, Vol. 2, No. 1.
            (3) Acceptance: within specified range.
      5) Density: ASTM C642.

END OF SECTION 01 45 35

SECTION 01 74 00 – CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specifications Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes provisions for maintaining structures and the Site in a standard of cleanliness. All Subcontractors are responsible for cleaning and waste management pertaining to the operations of their trade in accordance with this Section.

B. Related Sections: In addition to standards described in this Section, comply with all requirements for cleaning up as described in various other Sections of these Specifications.

1.3 QUALITY ASSURANCE

A. Inspection:
   1. Daily and more often if necessary.
   2. Conduct inspections to verify that requirements of cleanliness are being met.

1.4 DELIVERY, STORAGE AND HANDLING

A. Hazards Control:
   1. Volatile Wastes:
      a. Store in covered metal containers.
      b. Remove from premises daily.
   2. Prevent accumulation of wastes which create hazardous conditions.
   3. Provide adequate ventilation during use of volatile or noxious substances.

1.5 PROJECT CONDITIONS

A. Cleaning and Disposal:
   1. Conduct operations to comply with local ordinances and anti-pollution laws.
   2. Not Allowed:
      a. Burning or burying of rubbish or waste materials onsite.
      b. Disposal of volatile wastes in storm or sanitary sewers: Volatile wastes include, but are not limited to, mineral spirits, oil or paint thinner.
      c. Disposal of wastes into streams or waterways.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Compatibility:
   1. Compatible with the surface being cleaned.
   2. Recommended by the Manufacturer of the material being cleaned.
   3. As reviewed by Construction Manager.

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

A. General:
1. Store Materials:
a. In an orderly arrangement allowing maximum access.
b. To allow unimpeded drainage and traffic.
c. Provide for the required protection of materials.
2. Scrap, debris, waste material and other items not required for construction of the Work:
a. Do not allow accumulation.
b. Remove from Site at least each week and more often if necessary.
c. Provide adequate storage for all materials awaiting removal.
3. Observe all requirements for fire protection and protection of the environment.

B. Site:
1. Daily, and more often if necessary:
a. Inspect the Site.
b. Pick up all scrap, debris and waste material; remove all such items to the place designated for their storage.
2. Weekly, and more often if necessary:
a. Inspect all arrangements of materials stored onsite.
b. Restack or otherwise service all arrangements to meet the requirements of paragraph 3.1.A.1 above.
3. At all times maintain the Site in a neat and orderly condition which meets the approval of Construction Manager.
4. Paved Surfaces: Keep clean.
5. Dust Control:
a. Control dust on or near the Work by the application of water or other approved means.
b. If Subcontractor fails to correct unsatisfactory conditions with 24 hours after due notification:
1) Construction Manager may arrange for such work to be performed by other means.
2) Pay costs.

C. Structures:
1. Weekly, and more often if necessary:
a. Pick up all scrap, debris and waste material; remove all such items to the place designated for their storage.
b. Sweep all Interior Spaces Clean. Clean as used above shall be defined to be free from dust and other material capable of being removed by reasonable diligence using a hand-held broom.
2. Preparation for installation of succeeding material:
a. Clean the structures or pertinent portions thereof:
1) To the degree of cleanliness recommended by the Manufacturer of the succeeding material.
2) Using all equipment and materials required to achieve the required cleanliness.
3. Schedule cleaning operations so that dust and other contaminants resulting from cleaning operations will not fall on wet, recently painted surfaces.

3.2 FINAL CLEANING

A. Definitions for Clean: The level of cleanliness generally provided by commercial building maintenance subcontractors using commercial quality building maintenance equipment and materials.

B. Prior to Completion of the Work:
1. Remove from the Site all tools, surplus materials, equipment, scrap, debris and waste.

C. Site:
1. Unless otherwise specifically directed by Construction Manager:
a. Hose down all paved areas onsite and all public sidewalks directly adjacent to the Site.
b. Rake clean other surfaces of the grounds.
2. Remove all resultant debris.

D. Timing: Schedule final cleaning as approved by Construction Manager to enable Owner to accept a completely clean Project.

3.3 OWNER OCCUPANCY PRIOR TO SUBSTANTIAL COMPLETION AND ACCEPTANCE

A. If Owner occupies the Work, or a portion of the Work, prior to Substantial Completion and acceptance, then each Subcontractor is responsible to minimize disruption to Owner's operations and maintain the established cleanliness of the area.

END OF SECTION 01 74 00

SECTION 01 75 00 – STARTING AND ADJUSTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes provisions for facility startup and demonstration of the following systems:
   1. Equipment.
   2. Mechanical Systems.
   3. Electrical systems.

1.3 SUBMITTALS

A. Preliminary Schedules:
   1. Submit 2 weeks prior to earliest proposed date.
   2. List time and date for the following for each system:
      a. Startup.
      b. Demonstration.

B. Completion Reports:
   1. Submit within 1 week after each system demonstration.
   2. List time, date and persons present for the following for each system:
      a. Start-up.
      b. Demonstration.
   3. Include Manufacturer's representative's report indicating:
      a. Approval of installation.
      b. Satisfactory start-up.
      c. Functioning correctly.
   4. Indicate that demonstration and instructions were satisfactorily completed.

1.4 QUALITY CONTROL

A. Manufacturer's Field Services:
   1. Provide when required by individual Section.
   2. Provide the following services except where indicated otherwise in individual Sections.
      a. Inspect, check and approve system installation.
      b. Supervise system start-up.
      c. Provide written report indicating that system:
         1) Has been properly installed and lubricated.
         2) Is in accurate alignment.
         3) Is free from undue stress imposed by connecting lines or anchor bolts.
         4) Has been satisfactorily operated under full load conditions.
      d. Demonstrate operation of system to Owner's personnel.
      e. Instruct Owner's personnel on operation and maintenance of system.

1.5 PROJECT CONDITIONS

A. Verify that:
   1. Excess packing and shipping bolts have been removed.
   2. Interdependent systems have been checked and are operational.

1.6 CORRECTION PERIOD

A. Provide periodic continuing warranty services as necessary to ensure proper functioning of mechanical systems after occupancy of the Project, and for a period of 1 year after date of Substantial Completion.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 STARTING OF SYSTEMS

A. Inspection:
   1. Verify that Project conditions comply with requirements.
   2. Verify that status of Work meets requirements for starting of systems.

B. Preparation:
   1. Coordinate sequence for start-up of various systems.
   2. Notify Construction Manager 7 days prior to start-up of each system.
   3. Have at hand during entire start-up process:
      a. Contract Documents.
      b. Shop Drawings.
      c. Product data.
      d. Operation and maintenance data.
   4. Verify that each piece of equipment has been checked for:
      a. Proper lubrication.
      b. Drive rotation.
      c. Belt tension.
      d. Control sequence.
      e. Other conditions which may cause damage.
   5. Verify control systems are fully operational in automatic mode.
   6. Verify that tests, meter readings and specific electrical characteristics agree with those specified by electrical equipment Manufacturer.
   7. Bearings:
      a. Inspect for cleanliness, clean and remove foreign materials.
      b. Verify alignment.
      c. Replace defective bearings and those which run rough or noisy.
      d. Grease as necessary and in accordance with Manufacturer's recommendations.
   8. Drives:
      a. Adjust tension in V-belt drives, and adjust vari-pitch sheaves and drives for proper equipment speed.
      b. Adjust drives for alignment of sheaves and V-belts.
      c. Clean, remove foreign materials before starting operation.
   9. Motors:
      a. Check each motor for amperage comparison to nameplate value.
      b. Correct conditions which produce excessive current flow and which exist due to equipment malfunction.
   10. Pumps:
      a. Check mechanical seals for cleanliness and adjustment before running pump.
      b. Inspect shaft sleeves for scoring.
      c. Inspect mechanical faces, chambers and seal rings; replace if defective.
      d. Verify that piping system is free of dirt and scale before circulating liquid through the pump.
      e. Check Pump Performance:
         1) Install a pressure gage on the discharge side of the check valve following pump.
         2) Operate the pump at all system operating heads.
            a) Verify pump operation with the Manufacturer's pump curve.
            b) Report deviations to Engineer.

3) Operate the pump through several cycles while observing the pressure gage.
   a) Watch pressure gage for several minutes after pump shut down.
   b) Report significant pressure variations to Engineer.
4) Remove pressure gage and plug tap.

11. Control Valves:
    a. Inspect both hand and automatic control valves; clean bonnets and stems.
    b. Tighten packing glands to ensure no leakage, but permit valve stems to operate without galling.
    c. Replace packing in valves to retain maximum adjustment after system is judged complete.
    d. Replace packing on any valve which continues to leak.
    e. Remove and repair bonnets which leak.
    f. Coat packing gland threads and valve stems with a surface preparation of "Moly-Cote" or "Fel-Pro" after cleaning.
    g. Verify that control valve seats are free from foreign material and are properly positioned for intended service.
12. Flanges:
    a. Tighten flanges after system has been placed in operation.
    b. Replace flange gaskets which show any sign of leakage after tightening.
13. Screwed Joints:
    a. Inspect screwed joints for leakage.
    b. Promptly remake each joint which appears to be faulty; do not wait for rust to form.
    c. Clean threads on both parts, apply compound and remake joints.
14. Cleaning:
    a. After system has been placed in operation, clean strainers, dirt pockets, orifices, valve seats and headers in fluid systems, to ensure being free of foreign materials.
    b. Open steam traps and air vents; remove operating elements. Clean thoroughly, replace internal parts, and put back into operation.
    c. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
15. Draft Gages: Set and calibrate draft gages of air filters and other equipment.
16. Fan Wheels:
    a. Inspect fan wheels for clearance and balance.
    b. Provide factory-authorized personnel for adjustment when needed.
17. Control Circuits:
    a. Check each electrical control circuit to ensure that operation complies with Specifications and requirements to provide desired performance.
18. Pressure Gages:
    a. Inspect each pressure gage and thermometer for calibration.
    b. Replace items which are defaced, broken or which read incorrectly.
19. Repair damaged insulation.
20. Venting and Drainage:
    a. Vent gases trapped in any part of systems.
    b. Verify that liquids are drained from all parts of gas or air systems.
21. Leaks: Check piping for leaks at every joint and at every screwed, flanged or welded connection using "Leak-Tek" or other approved compound.

C. Start-up:
   1. Execute start-up under supervision of responsible persons in accordance with Manufacturer's instructions.
   2. Place equipment in operation in proper sequence.

3.2 SYSTEMS DEMONSTRATION

A. Preparation:
   1. Verify that system:
      a. Has been inspected and put in service.
      b. Is fully operational.
   2. Operation and Maintenance Manuals:
      a. Completed.
      b. Sufficient copies available for use in demonstrations and instructions.

B. Demonstrations and Instructions:
   1. Demonstration of and instruction on operation and maintenance of system:
      a. To Owner's personnel.
      b. Two weeks prior to Substantial Completion.
   2. Equipment requiring seasonal operation: Demonstrate within 12 months.
   3. Instruction:
      a. Operation and maintenance manual as basis.
      b. Review contents of manual in detail.
      c. Explain all aspects of operation and maintenance.
   4. Demonstrate:
      a. Start-up.
      b. Operation.
      c. Control.
      d. Adjustment.
      e. Troubleshooting.
      f. Servicing.
      g. Maintenance.
      h. Shutdown.

3.3 PERFORMANCE TEST

A. Performance Test:
   1. Test the entire Work, including all of its individual systems for 2 weeks before final payment will be made.
   2. Make final tests in the presence of Owner, Construction Manager and Engineer.
   3. If any part of the Work or equipment does not meet Specifications:
      a. Correct the situation.
      b. Obtain approval of Engineer before final payment is made.
   4. Provide the personnel and bear all costs for correcting all malfunctions.
   5. Owner will provide operating personnel and utilities.

END OF SECTION 01 75 00

SECTION 01 77 00 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the instructions for and the responsibilities of each party in contract closeout.

1.3 SUBSTANTIAL COMPLETION

A. Construction Manager: When Construction Manager considers that the Work or any portion of the Work is ready for its intended use, Construction Manager shall submit:
   1. Written certification to Engineer and Owner that the Work, or designated portion of the Work, is substantially complete.
   2. A list of major items to be completed or corrected.
   3. Request that Architect/Engineer issue a certificate of Substantial Completion.

B. Architect/Engineer's Inspection: Architect/Engineer will make an inspection:
   1. Within 10 days after receipt of certification.
   2. Together with Owner and Construction Manager.

C. Architect/Engineer's Determination of Substantial Completion:
   1. Should Engineer consider the Work or designated portion of the Work substantially complete, the following steps shall be taken:
      a. Construction Manager shall prepare and submit to Architect/Engineer, a list of items to be completed or corrected as determined by the inspection.
      b. Architect/Engineer will prepare and deliver to Owner:
         1) A tentative certificate of Substantial Completion.
         2) A tentative list of items to be completed or corrected before final payment.
      c. Owner shall have 7 days after receipt of the tentative certificate during which to make written objection to Architect/Engineer as to any provisions of the certificate or attached list.
      d. Architect/Engineer will, within 14 days after delivery of tentative certificate to Owner, decide:
         1) Not Substantially Complete: Architect/Engineer will issue written notice to Construction Manager stating reasons.
         2) Substantially Complete: Architect/Engineer will issue definitive certificate of Substantial Completion and a revised list of items to be corrected or completed.
   2. Should Construction Manager consider that the Work or designated portion of the Work is not substantially complete, the following steps shall be taken:
      a. Construction Manager shall notify Subcontractor in writing stating Construction Manager's reasons.
      b. Subcontractor shall complete the Work and send a second written notice to Construction Manager certifying that the Project, or designated portion of the Project, is substantially complete.
      c. Construction Manager, Architect/Engineer, and Owner will reinspect the Work.

D. Division of Responsibilities:
   1. Architect/Engineer and Construction Manager:
      a. At the time of delivery of tentative certificate of Substantial Completion.
      b. Deliver to Owner a written recommendation as to division of responsibilities pending final payment with respect to:
         1) Security.
         2) Operation.
         3) Safety.

4) Protection of the Work.
5) Maintenance.
6) Heat.
7) Utilities.
8) Insurance.
9) Warranties.

2. Architect/Engineer's and Construction Manager's written recommendation on division of responsibilities shall be binding on Owner and Construction Manager until final payment unless Owner and Construction Manager agree otherwise in writing and so notify Construction Manager prior to Construction Manager's issuance of a definitive certificate of Substantial Completion.

1.4 FINAL INSPECTION

A. Subcontractor Certification: Prior to final inspection, Subcontractor shall submit written certification that:
1. The Contract Documents have been reviewed.
2. The Project has been inspected in compliance with the Contract Documents.
3. Work has been completed in accordance with the Contract Documents.
4. Equipment and systems have been tested in the presence of the Construction Manager's representative and are operational.
5. The Project is complete and ready for final inspection.

B. Architect/Engineer's Inspection: The Engineer will make final inspection:
1. Within 10 days after receipt of certification.
2. Together with Owner and Construction Manager.

C. Architect/Engineer's Determination of Final Completion:
1. Should Architect/Engineer consider the Work complete and ready for final payment in accordance with the requirements of the Contract Documents, Construction Manager shall request Subcontractor to make Project closeout submittals.
2. Should Architect/Engineer consider the Work not complete and ready for final payment:
a. Architect/Engineer shall notify Construction Manager in writing stating the reasons.
b. Construction Manager:
1) Take immediate steps to remedy the stated deficiencies.
2) Send a second written notice to Engineer certifying that the Work is complete.
c. Architect/Engineer and Owner will reinspect the Work.

1.5 REINSPECTION COSTS

A. Should Architect/Engineer be required to perform additional inspections because of failure of the Work to comply with the original certifications of Subcontractor, Construction Manager will compensate Engineer for additional services and the amount will be deducted from the amount paid to Subcontractor.

1.6 CLOSEOUT SUBMITTALS

A. Subcontractor:
1. Provide closeout submittals as required in the Contract Documents.
2. These submittals shall include, but not necessarily be limited to:
a. Project record documents.
b. Operation and maintenance manuals.
c. Equipment warranties.
d. Spare parts and maintenance materials.
e. Instruction in operation of all systems.
f. Workmanship warranty.
g. Current insurance certificate.

1.7 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

A. Affidavits:
   1. Submit with final Application for Payment an affidavit of payment of debts and release of claims.
   2. Affidavit shall include:
      a. Consent of Surety to Final Payment (if applicable).
      b. Final Sworn Statement.
      c. Full Unconditional Waiver for each subcontractor/vendor listed on your sworn statement.

B. Execution: All submittals shall be duly executed before delivery to Construction Manager.

1.8 FINAL ADJUSTMENT OF ACCOUNTS

A. Final Statement: Submit a final statement of accounting, which reflects all adjustments, to Construction Manager. This statement shall contain the following:
   1. Original Contract Price.
   2. Additions and deductions.
   3. Total Contract Price as adjusted.
   4. Previous payments.
   5. Sum remaining due.

B. Final Change Order: Construction Manager will prepare a final Change Order reflecting approved adjustments to the Contract Price not previously made by Change Orders.

1.9 FINAL APPLICATION FOR PAYMENT

A. Subcontractor shall submit a final Application for Payment in accordance with the requirements of the Contract Documents.

B. Disposition of Final Application for Payment:
   1. If the final Application for Payment and the Work are acceptable in accordance with the Contract Documents:
      a. Construction Manager will, within 10 days after receipt of the Application for Payment: Submit to Owner a final application for payment.
   2. If the Application for Payment, the Work or both are unacceptable:
      a. Construction Manager will return the Application for Payment to Subcontractor, indicating in writing the reasons for refusing final payment.
      b. Subcontractor shall make the necessary corrections and resubmit the Application for Payment.
   3. Final Completion Delayed:
      a. Upon receipt of Subcontractor's final Application for Payment and recommendation by Construction Manager and Engineer, Owner shall make payment of the balance due for that portion of the Work fully completed and accepted if Construction Manager confirms that final completion of the Work is significantly delayed through no fault of Subcontractor.
      b. Payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.
      c. Subcontractor shall submit with the Application for Payment written consent of surety if the remaining balance to be held by Construction Manager for Work not fully completed or corrected is less than the retainage stipulated in the Agreement.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 77 00

SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedures for the maintenance, recording and submittal of Project record documents.

1.3 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Storage: Store documents and Samples in Subcontractor's field office apart from documents used for construction.

B. Filing: File record documents in accordance with CSI Masterformat.

C. Maintenance:
1. Maintain documents in a clean, dry, legible condition and in good order.
2. Do not use record documents for construction purposes.

D. Availability: Make documents and Samples available at all times for inspection by Construction Manager.

1.4 RECORDING

A. Labeling: Label each document "PROJECT RECORD" in neat large printed letters.

B. Recording:
1. Record actual revisions to the Work.
2. Record information concurrently with construction progress.
3. Do not conceal any work until required information is recorded.

C. Drawings:
1. Legibly mark, with notes or graphic representations, to record actual construction.
   a. Depths of various elements of foundations and piping in relation to approved datum.
   b. Horizontal and vertical locations of Underground Facilities and appurtenances, referenced to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
   d. Field changes of dimension and detail.
   e. Changes made by Field Order, Work Change Directive or Change Order.
   f. Details not on original Contract Drawings.

1.5 SUBMITTAL

A. Delivery:
1. At Contract closeout, deliver record documents to Construction Manager for Owner.
2. Submit only Contract Documents marked up. Three dimensional models, shop drawings, or other representations of the Project created by the Subcontractor from the Contract Documents will not be accepted.

B. Transmittal Letter:
   1. Accompany submittal with transmittal letter, containing:
      a. Date.
      b. Project title and number.
      c. Subcontractor's name and address.
      d. Title and number of each Record Document.
      e. Signature of Subcontractor or their authorized representative.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 78 39

SECTION 03 11 00 – CONCRETE FORMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the design, installation and removal of forms for cast-in-place concrete.

B. Division of Work:
1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   a. Mechanical, Electrical and Plumbing Trades: Supply, locate and install premanufactured items including inserts, sleeves, and other embedded items required by those respective trades.
   b. Formwork Subcontractor:
      1) Supply and install Site fabricated box-outs for chases, sleeves and other openings for mechanical, electrical and plumbing trades.
      2) Install other inserts, embedded parts, box-outs for openings, chases, reveals and recesses, except those specifically mentioned above that are by mechanical, electrical or plumbing trades. Special inserts, embedded parts or other special requirements needed by a specific trade shall be supplied by that trade to the formwork Subcontractor for installation.
   c. Contractor: Coordinate location of mechanical, electrical and plumbing inserts, embedded parts, openings and recesses with respective trades.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
1. ACI – American Concrete Institute:
   a. 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
   b. 301 – Standard Specifications for Structural Concrete for Buildings.
   c. 303R – Guide to Cast-In-Place Architectural Concrete Practice.
   d. 347R – Guide to Formwork for Concrete.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Form Construction:
1. Provide required forms, shores, bracing, breast timbers, form ties, and accessories in sufficient quantities so as not to delay the Work, and of strength to support vertical and horizontal loads to which they are subjected.
2. Deflection: Maximum deflection of forms shall be 1/240 of span or 1/4-inch, whichever is less.

1.5 SUBMITTALS

A. Manufacturer's Literature: For form release agent and form liners.

B. Form Liner Samples:
1. Submit 3 Owner selected form liner Sample panels, each 2 feet x 2 feet.
2. Owner will make final selection from these Samples.

1.6 QUALITY ASSURANCE

A. Design: The design and engineering of formwork, as well as its construction, shall be the responsibility of Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Formwork Facing Materials:
   1. Smooth Form Finish Areas:
      a. Locations: All locations unless otherwise noted.
      b. The form facing material shall produce a smooth, hard, uniform surface on the concrete.
      c. Form facing materials may be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper; or other approved material capable of producing the desired finish.
      d. Facing materials shall be supported by studs or other backing capable of preventing deflections in excess of those specified herein.
      e. Material with damaged surfaces, worn edges, patches, dents or other defects which will impair the texture of the concrete surface shall not be used.

B. Cylindrical Forms:
   1. Steel or fiberglass, formed to diameters required to produce indicated shapes.
   2. Strong enough to carry pressure of plastic concrete.
   3. Formed to produce shapes free from abrupt changes in shape, and to produce smooth uniform surface.
   4. Products made of spirally wound laminated paper, such as Sonotube, will be allowed for light pole bases and surfaces unexposed in the final installation.
      a. Form other surfaces exposed in the final installation with 2-piece forms.

C. Chamfer Strips:
   1. Wood, metal, rubber, or PVC.
   2. Sizes as indicated, 3/4-inch x 3/4-inch minimum.

D. Form Ties:
   1. At Smooth Form Finish Areas:
      a. Factory fabricated metal ties.
      b. Removable or snap type, with tapered cones as required to leave no tie portion within 1-inch of concrete surface plane.
      c. Designed to leave no larger than a 7/8-inch diameter hole at concrete surface.
      d. Chosen by Contractor to suit application and to resist pressure of fresh concrete.
      e. For liquid containing or resisting walls, such as tanks, trenches, basement walls and elevator pits, in addition to the above requirements, provide waterstop type feature on the tie.

E. Form Release Agent:
   1. Chemically neutral agent in hydrocarbon solvent that will effectively prevent absorption of moisture and prevent bond with the concrete.
   2. Non-staining and compatible with form liners and finish coats specified in Division 09.

PART 3 - EXECUTION

3.1 FORMWORK CONSTRUCTION

A. General:
   1. Install wall form ties in a regular repetitive pattern.
   2. Align and secure joints to avoid offsets.
   3. Provide chamfered strips in exposed corners of concrete stair stringers, piers, columns, beams, spandrels, internal corners and for similar conditions throughout the Work.
   4. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.

5. The arrangement of facing material shall be orderly and symmetrical with the number of seams kept to the practical minimum.
6. Retighten forms after concrete placement if required to eliminate mortar leaks.
7. Inspection Ports and Cleanouts:
   a. Provide temporary openings where interior area of formwork is inaccessible for cleanout and inspection.
   b. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar.
   c. Locate temporary openings on forms at inconspicuous locations.
8. Provisions for Architectural Treatment:
   a. For walls with architectural finish such as sandblasting or form liner, apply tape to form joint to prevent projecting fins.
   b. At form liner locations, follow Supplier's recommendations for installation.
   c. Ties at walls with architectural finish shall be in a 2'-0" x 2'-0" pattern.
   d. At plastic form liner locations, calk a 1/8-inch bead around tie at form.

B. Openings and Embedded Items:
1. Set and build into the work anchorage devices and other embedded items required for work that is attached to, or supported by, cast-in-place concrete.
2. Coordinate work of other Sections and cooperate with trade involved in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchor and other inserts.
3. Use setting drawings, diagrams, instructions and directions provided by Suppliers of the respective items.
4. Do not perform work unless specifically indicated on Drawings or reviewed prior to installation.
5. Build in dovetail anchor slots vertically.

C. Cleaning:
1. Clean forms as erection proceeds, to remove foreign matter.
2. Remove cuttings, shavings and debris from within forms.
3. Flush with water or use compressed air to remove remaining foreign matter.
4. Ensure that water and debris drain to exterior through clean-out ports.
5. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints.

D. Applying Form Release Agent:
1. Temperature of release agent and surfaces to which it is applied shall be a minimum of 70 degrees F.
2. Apply by spray only.
3. Uniformly coat surfaces with a thin film.
4. Wipe off excess with clean towels.
5. Apply in accordance with Manufacturer's recommendations.
6. Do not allow to stand in puddles in the forms and prevent bonding of concrete at construction joints.

E. Provisions for Form Removal:
1. Fabricate forms for easy removal without hammering or prying against the concrete surfaces.
2. Kerf wood inserts for forming keyways, reglets, recesses and the like to prevent swelling and for easy removal.

3.2 FORM AND SUPPORT REMOVAL

A. Forms and supports shall remain in place for not less than the following periods of time:
1. Building Foundations and Walls: 12 to 24 hours.

B. In any event, do not remove forms and supports until concrete in walls has reached 30% of design strength, and in structural members and slabs has reached 75% of design strength.

C. Special precautions shall be taken when concrete is placed in average temperatures of 50 degrees F or below to ensure that forms are not removed before design strengths specified above are met.

D. If Contractor elects to use high-early-strength cement, the specified periods of time may be reduced as allowed by Engineer. This does not relieve Contractor of Contractor's liability.

E. Remove forms in such a manner and at such times as required to ensure safety of persons involved and so as to protect and maintain structural integrity of members.

F. Particular care shall be taken in removing forms to minimize damage to concrete surfaces; use crush or wrecking plates as necessary.

G. Whenever the formwork is removed, cure the exposed concrete as specified under Division 03 Section “Structural Concrete.”

3.3 FIELD QUALITY CONTROL

A. Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties and parts are secure.

B. Form Surface Repairs:
   1. Repair surfaces of forms to be reused in the work.
   2. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable.
   3. Apply new form release agent to new concrete contact form surfaces.
   4. Do not use patched forms for exposed concrete surfaces.

C. Special Inspections:
   1. Inform special inspector when formwork is complete and has been cleaned, to allow for inspection.
   2. Allow inspection of each section of plywood type of formwork prior to reuse.
   3. Obtain inspections prior to placing concrete.

END OF SECTION 03 11 00

SECTION 03 15 00 – CONCRETE ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of concrete accessories.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. D1751 – Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
      b. E96 – Water Vapor Transmission of Materials.
      c. E1643 – Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
      d. E1745 – Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
   2. AASHTO M 153 – Preformed Sponge Rubber, Cork and Recycled Rubber Expansion Joint Fillers for Concrete Paving and Structural Construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Dovetail Slots:
   1. 22 gage, galvanized steel, 1-inch wide back.
   2. Crimped Anchors: In accordance with Division 04.

B. Inserts for General Trades:
   1. Malleable iron and steel, strength as required.
   2. Include bolts, nuts and washers.
   3. All steel shall be galvanized.

C. Premolded Expansion Strips:
   1. Asphalt Impregnated Fiberboard:
      a. W. R. Meadows, Inc.; J & P Petroleum Products, Inc.; Celotex Corporation; or equal.
      b. In accordance with ASTM D1751.
      c. Thicknesses: 1/4-inch, 3/8-inch, 1/2-inch, 3/4-inch or 1-inch as indicated on the Drawings.
      d. Strip widths to match slab thickness.
   2. Vinyl Expansion Strips:
      a. ProFlex by Oscoda Plastics, Inc.; or equal.
      b. Material: 100% recycles vinyl.
      c. Thickness: 1/4-inch; 1/2-inch
      d. Strip widths to match slab thickness.

D. Construction Joint Form for Building Floor Slabs On Grade:
   1. Superior Concrete Accessories, Inc.; Heckman Building Products Company; or equal.
   2. 16-gage, tongue and groove galvanized steel.

E. Vapor Retarder: 10 mil Green by Reef Industries, Inc.; Stego Wrap Class A Vapor Retarder by Stego Industries, LLC; or equal.

F. Vapor Retarder/Barrier Accessories:
   1. Mastic Tape: Griffolyn Fab Tape; Stego Mastic; or equal.
   2. Repair Tape: Griffolyn Griff Tape; Stego Tape; or equal.
   3. Pipe Boots: Griffolyn Pipe Boots; or equal.

G. Other Materials: All other materials not specifically described but required for a complete and proper installation of concrete accessories shall be as selected by Contractor subject to the approval of Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Concrete Accessories:
   1. As indicated on the Drawings.
   2. As specified in various other Sections.
   3. As necessary for the proper and complete performance of the Work.

B. Dovetail Slots: Install at 2'-0" on center where masonry adjoins concrete.

C. Piping, Mechanical and Electrical Equipment Support: Refer to Division 03 Section “Concrete Forming.”

D. Vapor Retarder/Barrier:
   1. Install in accordance with Manufacturer’s instructions.
   2. Install vapor retarder/barrier on smooth compacted subgrade.
   3. Lap joints and seal with continuous mastic tape.
   4. Seal around penetrations with pipe boots and mastic tape.
   5. Repair damage to vapor retarder/barrier with repair tape, and with additional matching vapor retarder/barrier if required.
   6. Turn vapor retarder/barrier up and trim off flush with building floor slab where no expansion material is indicated.

END OF SECTION 03 15 00

SECTION 03 15 16 – POST-INSTALLED ANCHORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of post-installed anchors.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following pertinent provisions:
   1. ASTM:
      a. A36 – Carbon Structural Steel.
      b. A153 – Zinc Coating (Hot Dip) on Iron and Steel Hardware.
      c. A198 – Steel Bolting Materials for High-Temperature Service.
      d. A240 – Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
      e. A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      f. A510 – General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
      g. A563 – Carbon and Alloy Steel Nuts.
      h. B633 – Electrodeposited Coatings of Zinc on Iron and Steel.
      i. E488 – Strength of Anchors in Concrete and Masonry Elements.
      j. E1512 – Testing Bond Performance of Bonded Anchors.
      k. F436 – Hardened Steel Washers.
      l. F593 – Stainless Steel Bolts, Hex Cap Screws, and Studs.
      m. F594 – Stainless Steel Nuts.
      n. F844 – Washers, Steel, Plain (Flat), Unhardened for General Use.
   2. ACI:
      a. 318, Chapter 17 – Anchoring to Concrete.
      b. 355.2 – Qualification of Post-Installed Mechanical Anchors in Concrete.
      c. 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete.
   3. International Code Congress Evaluation Service – ICC-ES:
      a. AC-193 – Mechanical Anchors in Concrete Elements.
      b. AC-308 – Post-installed Adhesive Anchors in Concrete Elements.
   4. Michigan Building Code.

1.4 SUBMITTALS

A. Product Data: For each anchor type to be furnished for each base material to which it will be fastened, including:
   1. Anchor specific type, physical properties and installation procedures.
      a. General catalog sheets of anchors without specific reference are not acceptable.
   2. Strength developed by anchor in each base material to which each is being fastened.
   3. Anchor embedment depth in base material.
   4. Anchor material.
   5. ICC-ES Report for each specific anchor indicating compliance to applicable building code.

1.5 QUALITY ASSURANCE

A. Provide special inspections of post-installed anchors in accordance with Division 01 Section “Special Inspections and Tests.”

B. Compliance:
   1. Mechanical anchors shall comply with AC-193 and ACI 355.2.
   2. Adhesive anchors shall comply with AC-308 and ACI 355.4.

C. Installation Personnel Qualifications:
   1. Knowledgeable of the specific Manufacturer's requirements for proper installation of post-installed anchors.
   2. Anchor installers shall be properly trained by the anchor Manufacturer on Site.
      a. Anchor Manufacturer's representative shall not be a distributor or third party.
      b. The installers to be trained shall be the actual person or persons installing the anchors, not the foreman, superintendent or similar supervisory personnel.
      c. The on Site training shall include training for installation of each anchor in each substrate on the Project for each trade.
      d. Each person installing the anchor shall be trained.
      e. Anchor installation training shall take place prior to the installation of the anchors. The installer shall have training verification available for review at any time.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Hilti.

B. Products of the following manufacturers are among those which may be considered equal based on Submittals reviewed by Engineer; approval or rejection of the proposed or equal will be at Engineer's sole discretion:
   1. Powers/Rawl.
   2. Redhead.
   3. Simpson.

C. If Contractor intends to substitute other than Basis of Design products, Contractor shall be responsible to submit substitution product data that proves equivalence including, but not limited to:
   1. Capacities for specific anchor sizes, embedment lengths, and base materials into which the anchor will be fastened.
   2. Capacity reduction factors for spacing and edge distance.
   3. Material of each anchor type.
   4. ICC ES report applicable to each anchor type.

2.2 MATERIALS

A. Actual or Potential Ambient Conditions:
   1. Submerged or Corrosive Environment: Stainless steel in accordance with ASTM F593.
   2. Dry Areas: Mild steel, galvanized in accordance with ASTM B633, SC1, Type III.

2.3 POST-INSTALLED ANCHORS

A. Anchors that Resist Loads Through Mechanical Friction or Keying Forces:
   1. Expansion Anchors Approved for Use in Cracked Concrete:
      a. Wedge style anchor.
      b. Hilti Kwik Bolt TZ2 (ICC-ESR 4266).
      c. Capable of sustaining an ultimate load of 4 times the imposed load capacity in concrete when tested in accordance with ASTM E488.
   2. Expansion Anchors Approved for Use in Uncracked Concrete:
      a. Wedge style anchor.
      b. Hilti Kwik Bolt TZ2 (ICC-ESR 42660.
      c. Capable of sustaining an ultimate load of 4 times the imposed load capacity in concrete when tested in accordance with ASTM E488.

3. Sleeve Anchors Approved for Use in Cracked and Uncracked Concrete:
   a. Expanding sleeve style anchor.
   b. Hilti HSL-3 (ICC-ESR 1545).
   c. Hex, acorn, round or flat head anchor or threaded anchor with hex nut as situation requires or as indicated on the Drawings.
4. Undercut Anchors Approved for Use in Cracked and Uncracked Concrete:
   a. Expanding sleeve, self-undercutting wedge style anchor.
   b. Hilti HDA (ICC-ESR 1546).
   c. Hex or flat head anchor or threaded anchor with hex nut as situation requires or as indicated on the Drawings.
5. Screw Style Anchors Approved for Use in Cracked Concrete:
   a. Hilti Kwik HUS EZ (ICC-ESR 3027).
   b. Capable of sustaining an ultimate load of 4 times the imposed load capacity in concrete when tested in accordance with ASTM E488.
6. Expansion Anchors Approved for Use in Solid Grouted Masonry:
   a. Wedge style anchor.
   b. Hilti Kwik Bolt TZ2 (ICC-ESR 4561).
7. Screw Style Anchors Approved for Use in Solid Grouted Masonry:
   a. Hilti Kwik HUS EZ (ICC-ESR 3056).

B. Anchors that Resist Loads Through an Injectable Chemical Adhesive:
   1. In Concrete: Hilti HIT HY 200 Safe Set.
   2. In Solid Grouted Masonry: Hilti HIT-HY 270.
   3. In Hollow Brick or Hollow Masonry: Hilti HIT-HY 270 with screen tubes.
   4. Anchored Material: Carbon steel or stainless steel threaded rods or deformed reinforcing bars as specified herein or as indicated on the Drawings.
   5. Bonding Strength: Tested in accordance with ASTM E1512.
   6. If installation temperatures of base materials fall below 41 degrees F, review cold weather applications with Manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Pre-Construction Conference:
   1. At least 15 days prior to the installation of post-installed anchors, conduct a pre-installation conference at the Site.
      a. Repeat pre-installation conference as many times as is necessary to address all installers using post-installed anchors on the Project.
   2. Contractor shall be responsible for arranging the conference and agenda.
   3. Agenda shall include, but not be limited to:
      a. Reviewed and approved post-installed anchors for use in the Project.
      b. Anchor installation training (to be performed by Manufacturer's representative).
      c. Drilling requirements and restrictions for the anchors.
      d. Special inspection requirements.

3.2 INSTALLATION

A. Install post-installed anchors:
   1. In strict accordance with the installation instructions supplied by the Manufacturer.
   2. In rotary hammer drilled holes, unless otherwise approved by Engineer.
   3. In drilled out holes of the proper depth and diameter cleaned of dust and debris according to the Manufacturer's specific installation instructions.

B. Provide sizes, spacings, edge distances and embedment as indicated on the Drawings.

C. Anchors that Resist Loads Through an Injectable Chemical Adhesive:
   1. Install in concrete with minimum age of 21 days, and in masonry with a minimum age of 7 days.
   2. Do not apply load until adhesive has properly cured and developed specified strength where cure time shall be as called out in the Manufacturer's literature based on prevailing environmental conditions at the time of installation.

3.3 CLEANING

A. Clean materials installed under this Section according to Division 01 Section "Cleaning and Waste Management."

END OF SECTION 03 15 16

SECTION 03 21 00 – REINFORCING STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and placement of concrete reinforcement.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ACI:
      a. 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
      b. 315 – Details and Detailing of Concrete Reinforcement.
      c. 315R – Guide to Presenting Reinforcing Steel Design Details.
      d. 318 – Building Code Requirements for Structural Concrete.
   2. ASTM:
      a. A185 – Steel Welded Wire Reinforcement, Plain, for Concrete.
      b. A615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
      c. A706 – Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
      d. A1064 – Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   3. AWS: D1.4: Structural Welding Code – Reinforcing Steel.
   4. CRSI:
      a. Manual of Standard Practice.
      b. Reinforcing Bar Detailing.
      c. Placing Reinforcing Bars.

1.4 SUBMITTALS

A. Prepare Shop Drawings in accordance with ACI 315 and 315R and the CRSI Manual of Standard Practice and Reinforcing Bar Detailing. Include the following:
   1. Number, size, length, mark, and location of concrete reinforcement.
   2. Bending diagrams.

B. Certified Mill Test Reports:
   1. Submit upon request by Engineer.
   2. Showing physical and chemical analysis for each heat of reinforcement used on Project.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement free of loose rust, scale, paint, oil and structural defects, and store on the Site to maintain that condition.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Concrete Reinforcement and Accessories:
      a. New, free from rust, scale, paint, oil, and structural defects.
      b. The same sizes as indicated on the Drawings.

B. Reinforcing Bars:
   1. ASTM A615 or A706.
   2. Yield Stress: F_y = 60,000 psi.
   3. Deformed unless otherwise noted; smooth where specifically indicated on the Drawings.
   4. Where Engineer has allowed reinforcing to be welded, comply with ASTM A706.

C. Welded Wire Fabric:
   1. ASTM A185 or A1064.
   2. Yield Stress: F_y = 65,000 psi.
   3. Plain, cold drawn, electrically welded fabric.

D. Accessories:
   1. Chairs, bolsters, anchors, spacers, stirrups, ties, and other devices as required for spacing and fastening reinforcement in place.
      a. Conform to CRSI Manual of Standard Practice.
   2. At the exposed underside of concrete, use plastic-tipped chairs and bolsters.

2.2 FABRICATION

A. General:
   1. Fabricate reinforcement to the dimensions indicated on the Drawings and the reviewed Shop Drawings in accordance with the CRSI Manual of Standard Practice.
   2. Tolerances: As indicated in ACI 117.
   3. Bundle and tag reinforcement with suitable identification to permit checking, sorting and placing.
   4. Welding:
      a. Not permitted, unless specifically indicated on the Drawings.
      b. Only on ASTM A706 steel.
      c. When permitted, comply with AWS D1.4.
      d. No tack welding permitted.

B. Hooks:
   1. Bend hooks in accordance with ACI 318.
   2. Provide extension on 90-degree hook that meets the requirements of a standard hook unless indicated longer on the Drawings.
   3. Cold bend bars in such a way that will not damage the reinforcement.

C. Reinforcement with any of the following defects will not be permitted in the Work:
   1. Bar lengths, depths and bends exceeding specified fabrication tolerances.
   2. Bends or kinks not indicated on Drawings or reviewed Shop Drawings.
   3. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Place concrete reinforcement in accordance with:
   1. Shop Drawings reviewed by Engineer.
   2. CRSI:
      a. Placing Reinforcing Bars.
      b. Manual of Standard Practice.
   3. Tolerances indicated in ACI 117.

B. Clearance:
   1. Parallel Bars:
      a. Preserve clear space between bars of not less than:
         1) For round bars, the normal diameter of the bar.
         2) 1-inch.
         3) 1-1/3 times the maximum size of aggregate.

2. Bars in Upper Layers: Preserve a clear distance between layers of at least 1 inch.
3. Longitudinal Bars in Columns, Pedestal and Boundary Elements in Walls:
   a. Preserve clear space between bars of not less than:
      1) For round bars, 1.5 times the normal diameter of the bar.
      2) 1.5-inches.
      3) 1-1/3 times the maximum size of aggregate.
4. In the absence of specific cover requirements on the Drawings, provide the following minimum concrete cover for reinforcement:
   a. Cast Against and Permanently In Contact with Ground: 3 inches.
   b. Exposed to Weather or In Contact with Ground:
      1) No. 6 Through No. 18 Bars: 2 inches.
      2) No. 5 Bar, W31 or D31 Wire, and Smaller: 1-1/2 inches.
   c. Not Exposed to Weather or in Contact with Ground:
      1) Slabs, Joists and Walls:
         a) No. 14 and No. 18 Bars: 1-1/2 inches.
         b) No. 11 Bar and Smaller: 3/4-inch.
      2) Beams, Columns, Pedestals and Tension Ties: 1-1/2 inches.

C. Splices:
1. Comply with ACI 318 and this Section.
2. In the absence of specific lap requirements on the Drawings, lap in accordance with ACI 318, Class B.

D. Corner Bars:
1. Provide corner bars for horizontal wall steel.
2. In the absence of specific lap requirements on the Drawings, lap in accordance with ACI 318, Class B.

E. Field Cutting and Bending: Permitted only under special conditions reviewed by Engineer.

F. Field Welding:
1. In accordance with AWS D1.4.
2. Only when specifically indicated on the Drawings.
3. Only on ASTM A706 steel.
4. No tack welding permitted.

G. Welded Wire Fabric:
1. Block up, lap and tie welded wire fabric reinforcement.
2. Lap welded steel fabric 6 inches minimum at sides and ends.
3. Install welded wire fabric 1-inch from top of slabs.

H. Slabs On Grade:
1. Do not hook up welded wire fabric; either tie on supports at correct elevation or lay on partial slab thickness of fresh concrete just prior to placing remainder of slab.
2. For chairs or bolsters resting on soil, place on either:
   a. Sand plates.
   b. Concrete bricks set flush with soil to provide bearing surface for chairs or bolsters.

3.2 FIELD QUALITY CONTROL

A. Notification:
1. Notify special inspector when reinforcing is in place so reinforcement placement may be inspected.
2. Provide a minimum of 24 hours' notice prior to placement of concrete.

END OF SECTION 03 21 00

SECTION 03 31 00 – STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the design, furnishing and placement of cast-in-place concrete.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ACI – American Concrete Institute:
      a. 117 – Specification for Tolerances for Concrete Construction and Materials.
      b. 211.1 – Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
      c. 221.1R – Report on Alkali-Aggregate Reactivity.
      d. 301 – Specifications for Structural Concrete.
      e. 302.1R – Guide to Concrete Floor and Slab Construction.
      f. [303R – Guide to Cast-In-Place Architectural Concrete Practice.]
      g. 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
      h. 304.2R – Placing Concrete by Pumping Methods.
      i. 305R – Guide to Hot Weather Concreting.
      j. 306R – Guide to Cold Weather Concreting.
      k. 309R – Guide for Consolidation of Concrete.
      l. 318 – Building Code Requirements for Structural Concrete.
      m. 503.2 – Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.
   2. ASTM Publications:
      a. C33 – Specification for Concrete Aggregates.
      b. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      c. C94 – Specification for Ready-Mixed Concrete.
      d. C136 – Test Method for Sieve Analysis of Fine and Coarse Aggregates.
      e. C150 – Specification for Portland Cement.
      f. C227 – Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
      g. C260 – Specification for Air-Entraining Admixtures for Concrete.
      h. C295 – Guide for Petrographic Examination of Aggregates for Concrete.
      i. C309 – Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      j. C494 – Specification for Chemical Admixtures for Concrete.
      k. C595 – Blended Hydraulic Cements.
      l. C618 – Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
      m. C939 – Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
      n. C989 – Specification for Slag Cement for Use in Concrete and Mortars.
      o. C1105 – Test Method for Length Change of Concrete Due to Alkali-Carbonate Rock Reaction.
      p. C1107 – Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink).
      q. C1567 – Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar Bar Method).
   3. International Concrete Repair Institute (ICRI).
   4. MDOT – Standard Specifications for Construction.
   5. U.S. Army Corps of Engineers: CRD C621 – Non-Shrink Grout.
   6. AASHTO – Provisional Standard:
      a. TP 23 – Test Method for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

1.4 DEFINITIONS

A. Abbreviations:
   1. ASR: Alkali silica reactivity; alkali silica reaction.
   2. W/cm: Water to cementitious ratio.

B. Terms:
   1. Mass Concrete: Concrete with a thickness of 3′-0″ or greater.

1.5 SUBMITTALS

A. Manufacturer's Literature:
   1. Concrete Mix Designs:
      a. Refer to Part 2 of this Section to determine if mix designs shall be determined using trial mixtures or may be determined based on the concrete supplier's past performance test records.
         1) Allow for submittal and review of proposed trial mixtures and performing and submitting 28-day testing and subsequent review of trial mixtures, where required, in the Project's schedule.
      b. For Mix Designs Based on Supplier's Past Performance Test Records:
         1) Refer to procedures in Part 2 of this Section.
         2) Submit mix design constituents for each mix design, to include:
            a) Dry weights of cementitious materials.
            b) Saturated surface-dried weights of fine and coarse aggregates.
            c) Names, types and quantities of mix components.
            d) Weight of water.
            e) Type of mixing to be used as indicated in Item 11 of ASTM C94.
            f) Supplier's test results documenting the supplier's standard deviation of production and required target average compressive strength (f'_{cr}).
            g) Supplier's test records documenting that required target average compressive strength (f'_{cr}) can be achieved with submitted mix design.
         3) Submit to Engineer and obtain review prior to placing concrete.
   2. Product Data:
      a. Submit for each component of each mix design.
      b. Curing Agents:
         1) Submit for each type of curing agent.
         2) Include application rate required for each type of curing agent.
   3. ASR:
      a. If aggregate to be used in the Project's concrete mixes has ASR potential submit results of tests performed in accordance with ASTM C1567 or comparable ASTM test of concrete mixes using the same materials and sources as intended for use on this Project, demonstrating the elimination of ASR.
      b. Mortar bars constructed of cementitious materials and coarse and fine aggregates shall produce an expansion of less than 0.10% at 14 days in an accelerated test.
      c. Submittal may utilize testing within previous 2 years if materials and sources tested are the same as intended for use on this Project.

1.6 QUALITY ASSURANCE

A. Mix Designer Qualifications:
   1. Trained and experienced in the development of concrete mix designs.
   2. Knowledgeable of the design and the mix design procedures specified herein.

B. Batching and Placement Personnel Qualifications:
   1. Trained and experienced in the batching of concrete, and placement of concrete.
   2. Knowledgeable of the design and the reviewed Submittals.

C. Special Inspections of Concrete:
   1. In accordance with Division 01 Section “Special Inspections and Tests.”
   2. Test Reports: Submit reports of tests of production concrete, to include:
      a. Concrete compression.
      b. Yield, air content and slump tests.
      c. Water content.

D. ASR Potential:
   1. Determine in accordance with Appendix X1 of ASTM C33, ACI 221.1R and the tests stated therein.
   2. If local aggregates exhibit unacceptable potential ASR and will harm the finished concrete, either:
      a. Import nonreactive aggregates, or
      b. Provide a mix design modified by pozzolans or admixtures, or both, that eliminates the potential for ASR.
   3. Submit results of tests as specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cementitious Products:
   1. Cement:
      a. Portland cement, ASTM C150, Type I.
      b. Cements complying with ASTM C595, Type 1L or Type 1L(10) are permitted as a substitution for ASTM C150, Type 1 cement.
      c. Do not use different types of cement, different Manufacturers of cement, or different degrees of fineness on the Project.
   2. High Early Cement: Portland cement, ASTM C150, Type III, only with Engineer’s approval.
   3. Fly Ash: ASTM C618, Class C or F.
   4. Ground-Granulated Blast Furnace (GGBF) Slag: ASTM C989, Grade 100 or 120.

B. Aggregates:
   1. Grade aggregates according to procedures of ASTM C136.
   2. Aggregates: Inert, non-chemically reactive, and non-radioactive.
   3. Coarse Aggregates:
      a. Normal Weight Concrete:
         1) ASTM C33-5S, Number 67 (3/4-inch).
         2) ASTM C33-5S, Number 8 for concrete mixes in the Proportioning Schedule requiring 3/8-inch maximum coarse aggregate.
   4. Fine Aggregate: ASTM C33 or MDOT 2NS.
   5. Test aggregates for alkali-silica reactivity and provide mitigation method, if required, as specified herein.

C. Water: Clean, fresh and potable.

D. Admixtures:
   1. General:
      a. No admixture shall contain more than 0.1% water soluble chloride ions by mass of cementitious material.
      b. No admixture shall contain calcium chloride.
   2. Air-Entraining: ASTM C260.
   3. Mid-Range Water Reducer (MRWR): ASTM C494, Type A.
   4. Water Reducing and Retarding (WR&R): ASTM C494, Type D.
   5. Water Reducing and Accelerating (WR&A): ASTM C494, Type E.
   6. High Range Water Reducing (HRWR): ASTM C494, Type F.

E. Curing Agents:
   1. Comply with ASTM C309.
   2. Provide products which are compatible with floor coatings or toppings specified.
   3. Manufacturer shall guarantee that Manufacturer’s material is compatible with the intended application.
   4. Maximum VOC Limit: 350 g/L.

5. No wax-based compounds allowed.
6. No acrylics allowed where toppings or coatings are to be applied.
7. Curing Compound:
   a. Water based, dissipating.
   b. Type 1 – Clear or translucent without dye.
8. Curing and Sealing Compound:
   a. Vocomp 20 by W.R. Meadows.
   b. Safe Cure & Seal (J-18) by Dayton Superior.
   c. Cure and Seal 18E by Symons.
   d. Dress & Seal WB 30 by L & M Chemical.

2.2 MIXES

A. Delegated Design:
   1. The proportioning of concrete mix designs is a delegated design.
   2. The concrete Supplier shall be responsible for selection of the mix proportions in accordance with Option C as defined in ASTM C94 with the minimums as specified herein.
   3. Provide proportions of materials for concrete in accordance with ACI 211.1, in order to produce concrete with the specified compressive strength, minimal shrinkage, good placability and durability, and other specified properties.

B. Proportioning Based on Supplier's Past Performance Test Records:
   1. For all mix designs.
   2. Cementitious Content:
      a. Bid using the quantity of sacks of cementitious materials per cubic yard of concrete necessary to meet the requirements of this Specification. However, base the bid on an absolute minimum cementitious content of 5.5 sacks per cubic yard of concrete.
      b. Provide additional cementitious material, if required, to meet other requirements of this Specification.
   3. Meet the mix design criteria as noted in the Proportioning Schedule in this Section, regardless of the method of determining the required target average compressive strength below.
   4. To ensure concrete of adequate strength, select and document concrete proportions in accordance with ACI 318. This will determine the required target average compressive strength (f'_{cr}) of the concrete as supplied by the concrete production facility. The procedure is described below:
      a. The required target average compressive strength (f'_{cr}) of the concrete shall exceed the specified compressive strength (f'_c).
      b. Determine the amount by which the required target average compressive strength (f'_{cr}) must exceed the specified compressive strength (f'_c) by 1 of the following:
         1) Standard Deviation Approach:
            a) Where the concrete production facility has 15 or more consecutive tests for concrete composed of similar materials and with specified strengths within 1,000 psi of that specified for proposed work, calculate a standard deviation.
            b) This standard deviation is a measure of the variability of strength produced by the production facility for concrete of similar proportions.
            c) Calculate the required target average compressive strength (f'_{cr}) using this standard deviation and the appropriate formulas as given in ACI 318.
         2) ACI Required f'_{cr} Approach:
            a) Where the concrete production facility does not have test records meeting the required criteria, the required target average compressive strength (f'_{cr}) must exceed the specified compressive strength (f'_c) by 1,000 psi or more, in accordance with ACI 318 requirements.
      c. Provide documentation to demonstrate that the proposed concrete mix proportions will produce an average compressive strength equal to or greater than the required target average compressive strength (f'_{cr}). Documentation shall consist of 1 of the following:
         1) Past Performance Test Records:
            a) Where the concrete production facility has 10 or more field strength test records for concrete produced with similar materials and under similar conditions, those tests may be used to demonstrate that the proposed concrete proportions will produce the required target average compressive strength (f'_{cr}).

2) Trial Mix Test Records:
a) Where the concrete production facility does not have field strength test records for concrete produced with similar materials and under similar conditions, establish concrete proportions based on trial mixtures in accordance with ACI 318.

d. Submit mix design, test records, calculations and other documentation to Engineer at least 14 days prior to placement.
1) Should trial mixes be required because of the lack of qualifying test records, place no concrete until results from the 28-day tests have been reviewed by Engineer.

C. Proportioning Schedule: Refer to the Proportioning Schedule at the end of this Section for specific proportioning requirements.

D. Climatic Conditions: Adjust concrete mix design for climatic conditions.

2.3 SOURCE QUALITY CONTROL

A. Production and Delivery:
1. Batch, mix and transport ready mixed concrete in accordance with ASTM C94.
2. Concrete Delivery Tickets:
a. Before unloading each batch of concrete at the Site, furnish a delivery ticket on which is printed, stamped or written the following information:
1) Name of concrete batch plant.
2) Serial number of ticket.
3) Date and truck number.
4) Name of Contractor.
5) Job name and location.
6) Specific class or designation of concrete.
7) Amount of concrete (cubic yards).
8) Time loaded or of first mixing of cement and aggregates.
9) Type, name and amount of admixture.
10) Type, brand and amount of cement.
11) Total water content by producer (or water-cement ratio).
12) Maximum size of aggregate.
13) Weights of fine and coarse aggregates.
14) Absorption of fine and coarse aggregates.
3. Concrete delivered when the outdoor temperature is lower than 40 degrees F shall arrive at the Site having a temperature of not less than 60 degrees F and not greater than 90 degrees F unless otherwise specified or permitted by the Engineer.
4. Complete discharge of the concrete within 1-1/2 hours after introduction of mixing water to the cement or 1 hour after arriving at the Site, whichever is sooner, unless otherwise specifically approved by the Engineer.

PART 3 - EXECUTION

3.1 PLACEMENT

A. General: Place concrete in accordance with ACI 304R and ACI 304.2R.

B. Preplacement Inspection:
1. Before placing concrete, inspect and complete the formwork installation, reinforcing steel and items to be embedded or cast-in.
2. Notify other trades to permit the installation of their work; cooperate with other trades in setting such work, as required.
3. Ensure that forms have form release agents evenly applied in accordance with Manufacturer's recommendations.
4. Notify special inspector at least 24 hours in advance of placing.

C. Handling:
   1. Handle concrete from mixer to place of final deposit in carts, buggies, conveyors, pumps, or crane buckets.
   2. Do not deliver concrete by methods with a free fall of more than 3 feet.
   3. Crane buckets shall have a reinforced rubber chute which shall extend into formwork to minimize free fall of concrete and to eliminate separation of materials.
   4. Take every possible precaution to prevent separation or loss of ingredients while transporting concrete.
   5. Do not place concrete into standing water (unless approved tremie procedures are followed), and do not displace standing water with fresh concrete.

D. Method and Rate:
   1. Deposit concrete in horizontal layers in walls to avoid flowing along the forms.
   2. Horizontal layers shall not exceed 18 inches in thickness. Place in a manner to avoid inclined construction joints.
   3. Carry on placement at such a rate that concrete surfaces not yet to grade shall not have reached their initial set before additional concrete is placed.

E. Compaction:
   1. Mechanically vibrate concrete to thoroughly embed reinforcement and fixtures.
   2. Apply mechanical vibration directly to concrete.
   3. Apply vibration at point of deposit and in area of freshly placed concrete.
   4. Vibrations shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures but shall not be so long as to cause segregation of mix.
   5. Vibration shall ensure complete intermixing of concrete placed in different layers.
   6. Withdraw vibrator at the rate of 1-1/2 inches per second.
   7. Use vibrators designed to operate with vibratory element submerged in concrete, maintaining a speed of not less than 6,000 impulses per minute.
   8. Comply with ACI 309R.
   9. Do not use vibrators to transport concrete inside of forms.
   10. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine.
   11. Avoid inserting vibrators into lower layers of concrete that have begun to set by scheduling placement of concrete layers and concrete delivery.

F. Retempering:
   1. Do not add water to the concrete once it has left the concrete Supplier's plant.
   2. Concrete which has stood for 60 minutes is unacceptable; immediately remove from the premises, unless the use of the concrete is specifically approved by the Engineer.

G. Site Redosing with Water Reducer:
   1. 1 redosing of batched concrete at the Site may be permitted only under the following conditions:
      a. Redosing has been approved in advance by Engineer and water reducer Manufacturer.
      b. Equipment is on-Site to permit accurate measurable dispensing.
      c. Adequate supply of water reducer is on-Site.
      d. Engineer or special inspector witnesses the addition of water reducer, verifies the quantity, and witnesses the proper truck mixing of the redosed concrete.

H. Cold Weather Concrete Operations:
   1. Comply with the recommendations of ACI 306R.
   2. Recommended Protective Measures:
      a. Heating materials.
      b. Providing insulating blankets and windbreaks.
      c. Heated enclosures.
   3. Advise Engineer of planned protective measures.
   4. Straw or similar materials shall not be allowed.
   5. Do not use frozen materials or materials containing ice or snow.
   6. Do not place concrete on frozen subgrade.

I. Hot Weather Concrete Operations:
   1. Comply with the recommendations of ACI 305R.
   2. Recommended Protective Measures:
      a. Cooling materials.
      b. Concrete placement during cooler hours of the day.
      c. Providing shading and windbreaks.
   3. Advise Engineer of planned protective measures.

3.2 SURFACE TREATMENT

A. Formed Surface Finishes:
   1. Refer to Division 03 Section “Concrete Forming” for formwork facing materials and required finishes.
   2. Surface Treatment Definitions:
      a. As-Cast Finish: Finish achieved by using form-facing materials as indicated for as-cast finish in Division 03 Section “Concrete Forming”.
      b. Rough Form Finish:
         1) Patch tie holes, defects and bug holes greater than 1/2-inch diameter.
         2) Chip or rub off fins exceeding 1/2-inch in height.
         3) Leave surfaces with the texture imparted by the forms.
      c. Smooth Form Finish:
         1) Patch tie holes, defects and bug holes greater than 1/2-inch diameter.
         2) Remove fins exceeding 1/8-inch in height.
      d. Smooth Form (Potable Water) Finish:
         1) As defined above for As Cast and Smooth Form Finishes, except patch all bug holes regardless of size.
      e. Rubbed Finishes: Where indicated, provide rubbed finish as specified following after preparing surfaces to comply with an as-cast, smooth form finish.
         1) Smooth Rubbed Finish:
            a) Remove forms as early as permitted and perform necessary patching.
            b) Produce finish on hardened concrete no later than the day following formwork removal, by wetting the surface and rubbing it with carborundum brick or other abrasive until uniform color and texture are produced.
            c) Use no cement grout other than cement paste drawn from the concrete itself by the rubbing process.
            d) Cure as specified.
         2) Grout-Cleaned Rubbed Finish:
            a) Begin cleaning operations after contiguous surfaces to be cleaned are completed and accessible.
            b) Do not clean surfaces as work progresses.
            c) Wet the surface and apply grout consisting of one-part Portland cement and one and one-half parts fine sand with enough water to produce the consistency of thick paint. Match color of surrounding concrete.
            d) Scrub grout into voids and remove excess grout.
            e) When grout whitens, rub the surface and keep the surface damp for 36 hours afterward.
   3. Unless noted otherwise formed concrete surfaces shall have an As-Cast, Smooth Form finish.

B. Patching:
   1. General:
      a. Patch tie holes and defective concrete areas. Patch bug holes as specified for the required finish.
      b. Patches shall be acceptable to Engineer and reasonably match the adjacent concrete construction or the defective concrete shall be replaced.
   2. Patch Materials:
      a. Mortar with proportions and admixtures as close to the proportions of the concrete to be patched as possible.
         1) For exposed surfaces, mix different proportions of gray and white cement until exact color of surrounding concrete is obtained.
         2) Reduce coarse aggregate size to pea stone for patches under 1-1/2 inches thick.
         3) Omit coarse aggregate for patches under 1/2-inch thick.
         4) Mix mortar using water and epoxy bonding agent in 50:50 ratio.

5) Do not exceed the w/cm ratio specified for the surrounding concrete.
   a) Utilize water reducer, not water, if a greater slump than provided by the allowed water content is required to develop the workability required for the patch location.

3. Preparation:
   a. Sound concrete with a hammer or chains to determine limits of defective concrete.
   b. Mark limits of patch with chalk or paint.
   c. Limits of patch shall be straight and patch areas square or rectangular-shaped. Avoid acute angles.
   d. Saw cut marked limits perpendicular to member face to a depth of 1/2-inch to 5/8-inch into concrete, measured from concrete surface.
      1) Diamond blade saw or grinder with abrasive disk suitable for cutting concrete are acceptable for cutting marked limits.
      2) Exercise caution during saw cutting to avoid damaging reinforcement and other embedded items.
   e. Remove concrete from within marked limits to minimum depth of 3/4-inch using 15 pound maximum electric or pneumatic chipping hammers or hand tools, leaving a rough surface meeting CSP-7 as defined by ICRI.
   f. If the removal of defective concrete exposes reinforcement continue removal to provide a minimum of 3/4-inch clearance on all sides of (including behind) reinforcement, but deeper if necessary to reach sound concrete.
   g. After removals are complete, but prior to final cleaning, inspect cavity and exposed reinforcement. Notify Engineer for inspection; inspection will be at Engineer's option.
   h. Clean and air blast limits of removal to remove grit and deleterious material.
   i. Pre-dampen cavity surface with clean water. Concrete surfaces shall be saturated surface dry (SSD) with no free water at time of patch placement.
   j. Immediately prior to placing patch material, scrub neat cement mix into the surface of the patch area.
4. Patch Method:
   a. Use form and fill method or trowel fill method as determined by Contractor for patch location and conditions.
   b. Form and Fill:
      1) Forms and Form Release Agent: In accordance with Division 03 Section "Concrete Forming".
      2) Vibrate patch material to consolidate concrete, encapsulate embedded items, fill to patch limits and eliminate air pockets. Do not over vibrate.
      3) Leave forms in place for a minimum of 3 days.
      4) Immediately after removing forms, either wet cure or apply a minimum of 2 coats of curing compound in accordance with Manufacturer's recommendations.
   c. Trowel Fill:
      1) Work patch material thoroughly into prepared area, around embedded items, fully filling to the limits of the patch area and eliminating air pockets.
      2) Screed and trowel surface of patch to match the profile of the surrounding concrete.
      3) Immediately after finishing surface, either wet cure or apply at least 2 coats of curing compound in accordance with Manufacturer's recommendations.
5. Protect freshly applied concrete from premature drying and maintain with minimal moisture loss at a relatively constant temperature for a minimum of 7 days.

C. Finishing Floors:
   1. Unless noted otherwise provide the following on floors and slabs:
      a. Provide monolithic troweled finish.
      b. Vibratory screeding is required on concrete slabs.
      c. Suggested Finishing Procedure:
         1) Use highway straight edge to eliminate high and low spots.
         2) After screeding and as soon as concrete has set sufficiently, float surface with compactor power floats.
         3) Steel trowel surface.
      d. Burnish slabs to smooth, hard, dense finish free from trowel marks, blemishes and irregularities.
      e. Finish exterior platforms, walks, drives and steps to a broom surface. Leave a 2-inch border around panels in sidewalks and platforms.

f. At slab areas which receive a topping or grout base and tile, only power floating is required.

2. If no indication is given, comply with 1999 ACI 302.1R, Table 2.1.

D. Floor Finish Tolerances – Exterior Slabs:
1. In accordance with ACI 117 and 302.1R.
2. Interior building floors shall have a maximum sag of 1/8-inch under a 10-foot straight edge.
3. No “bird bath” allowed on sloping floor slabs.

E. Floor Finish Tolerances - Interior Slabs:
1. General:
a. F-Number system in accordance with ASTM E1155 shall be used to determine flatness and levelness.
b. Conformance to flatness and levelness requirements will be evaluated by special inspector in accordance with Division 01 Section “Special Inspections and Tests.”
c. Flatness and levelness shall be measured within 72 hours after completion of final troweling operations, and in all cases before forms or shores have been removed.
2. F-Numbers:
a. Flatness F-Number:
1) Overall Value: F_f (60).
2) Minimum Local Value: F_f (40).
b. Levelness F-Number:
1) Overall Value: F_l (40).
2) Minimum Local Value: F_l (25).
c. Grade Tolerance: Overall value ±0.50 inches.
3. Suggested Floor Construction Procedure:
a. Screed with rigid vibratory screed.
b. Close and straighten with a highway straight edge, filling low spots.
c. Screed with rigid vibratory screed.
d. Close and straighten with a highway straight edge, filling low spots.
e. Machine float surface.
f. Straighten with a highway straight edge, filling low spots.
g. Machine float surface.
h. Straighten with a highway straight edge, filling low spots.
i. Machine float surface.
j. Straighten with a highway straight edge, filling low spots.
k. First machine trowel surface.
l. Second machine trowel surface.
m. Final machine trowel surface.
4. Slab sections as defined by construction joints not meeting the F-number criteria shall be removed.

F. Curing Agents:
1. General Locations:
a. Curing: Surfaces not specified with curing and sealing compounds.
b. Curing and Sealing: As indicated on Drawings.
2. General:
a. Apply in strict accordance with Manufacturer’s instructions.
b. Coordinate curing compound chemical compatibility with coating subcontractor or finish surface subcontractor. Make adjustments at no additional cost to the Owner with the approval of the Engineer if necessary to ensure compatibility.
3. Curing Compound:
a. Apply immediately to slab areas requiring curing compound and immediately to walls after forms are removed.
b. Roll or spray compound in accordance with Manufacturer’s instructions. Apply each application at the rate in gallons per square foot and number of coats required to meet ASTM C309.

3.3 PROTECTION

A. Keep freshly placed concrete from damage due to low temperatures when the mean daily temperature is below 40 degrees F (4.5 degrees C) in accordance with ACI 306R.

3.4 JOINTS AND EMBEDDED ITEMS

A. Comply with ACI 318 and ACI 301.

B. Wall Joints: Avoid horizontal construction joints in walls below grade and in 1-story walls above grade.

C. Slab Joints:
1. Soil bearing slabs shall have construction or control joints as indicated on the Drawings.
2. Coordinate construction joints (and control joints as allowed herein) with Architectural Drawings and finishes.

D. Construction Joints:
1. Construct a keyway at construction joints in concrete.
2. In reinforced concrete, provide lap of reinforcing steel at construction joints, except where specifically indicated otherwise.

E. Embedments:
1. Contractor shall be responsible for controlling the proper placing of embedded pipe, conduit and other fixtures.
2. Comply with ACI 318 requirements.
   a. Embedments shall not impair or reduce the strength of the structure.
   b. Embed aluminum in concrete only when absolutely necessary; coat aluminum to be in concrete with a coating sufficient to prevent electrolytic reaction between aluminum and concrete.
3. Anchor rods shall be clean and free of oil, grease and dirt prior to installation.
4. Lay out locations of electrical and mechanical components prior to actual placement and obtain approval from Engineer before placing concrete.
5. Pipes and Conduits:
   a. Shall not displace reinforcing from its design locations.
   b. Shall not displace more than 4% of the concrete area on which strength is calculated or which is required for fire resistance.
   c. Outside diameter shall not be larger than 1/3 the overall thickness of the slab, wall or beam in which it is embedded.
   d. Shall not be spaced closer than 3 diameters apart.
   e. In structures with 2 layers of reinforcement, shall be placed between the layers.
   f. Maintain minimum concrete cover of 3/4-inches. Increase cover to 1-1/2 inches for concrete exposed to fluids or weather.
   g. Place additional reinforcing with an area greater than or equal to 0.002 times the area of the concrete section perpendicular to the piping or conduit.

3.5 SPECIFIC ITEMS OF CONSTRUCTION

A. Footings:
1. Provide required footings and equipment foundations for mechanical, electrical and architectural trades.
2. Adjustments will be made in Contract price if deeper footings are required in accordance with prior approval of Engineer.

B. Form Liner Walls:
1. Form liner walls occur at portions of foundation wall to be exposed to view at canopy.
2. Install in accordance with form liner Manufacturer's instructions.
3. Vibrate the concrete to the degree recommended by the form liner Manufacturer to prevent surface defects.
4. Ensure that differential movement due to temperature between the forms and the form liners will not cause surface defects.

C. Concrete Walls in Building:
1. Install dovetail anchor slots wherever masonry walls abut concrete walls. Install at 2′-0″ on center.
2. Construct control and construction joints as indicated on Drawings. Unless otherwise noted, locate joints directly below those in masonry, but with a maximum spacing of 20′-0″ on center.
3. Treat surfaces of concrete as specified after removing forms.

4. Apply curing agent to walls after removing forms.
5. Refer to Article 3.2 – Surface Treatment for concrete wall finish.

D. Concrete Slabs on Ground:
1. Structural Fill: Ensure fill and granular fill layer have been installed and compacted according to Division 31 Section "Excavation and Fill for Structures."
2. Only where indicated on the Drawings, at intersections of building floor slabs and vertical surfaces and around columns, install premolded expansion strips.
3. Install welded wire fabric indicated on the Drawings.
4. Vapor Retarders/Barriers: Where indicated below slabs, install in accordance with Division 03 Section "Concrete Accessories."

E. Concrete Columns:
1. Place concrete in columns slowly, in 1 operation, from top of footing or floor slab to the bottom of beams and girders.
2. Concrete in columns shall have attained initial set before beams or slabs are poured.
3. Use great care to prevent separation of materials.
4. Work concrete completely around reinforcement and built-in items.
5. Ensure that inserts and dovetail slots, where required, are in place before placing concrete.
6. Chamfer corners.

F. Exterior Stairs and Platforms: Apply broom finish to concrete.

G. Chamfer: Chamfer exposed concrete edges 3/4-inch x 3/4-inch unless otherwise indicated on the Drawings.

H. Miscellaneous Items: Perform concrete work for mechanical and electrical trades including but not limited to vaults, valve and meter pits, light pole bases and machine bases.

3.6 PROPORTIONING SCHEDULE (see also notes following schedule)

Mix Design	**1**	**2**	**3**
Use	General Building Foundations	Interior Building Floor Slabs	Exterior Floor Slabs
Minimum Cementitious Content (94 lb. sack)	Note 1	Note 1	Note 1
Fly Ash (Note 10)	20% to 35% combined	20% to 35% combined	20% to 35% combined
GGBFS			
Entrained Air (percent)	6 ± 1-1/2	0	6 ± 1-1/2
Maximum w/cm Ratio (Note 2)	0.48	0.48	0.45
Specified Maximum Coarse Aggregate	3/4″	3/4″	3/4″
Minimum Compressive Strength (psi) (Note 6)	4,000	4,000	4,000
Slump Before Adding Water Reducer (inches)	1-4	1-4	1-4
Slump After Adding Water Reducer (inches) (Notes 4 and 5)	5-8	5-8	5-8
Water Reducing Admixture Type (Notes 8 and 9)	Any Type Optional	Any Type Optional	Any Type Optional

NOTES:

1. Refer to mixes in Part 2 of this specification.
2. w/cm – Water to cementitious products ratio. All fly ash plus GGBF slag plus cement shall be included with w/cm ratio calculation.
3. GGBFS content for mass concrete shall be determined by the concrete mix designer to achieve the specified concrete properties, including temperature control.
4. Slumps indicated for mixes with water reducers are target ranges. Slumps outside these ranges are not necessarily grounds for rejection of the concrete. Use of concrete with slumps outside the indicated ranges shall be at Contractor's risk.
5. Slabs which slope more than 1/4-inch per foot shall have a slump after adding water reducer of 2-5 inches.
6. The compressive strength specified here and on the Drawings is the actual required specified compressive design strength (f'_c) at 28 days (unless noted otherwise) for the concrete structures on this Project, and is not to be considered the target strength (f'_{cr}) which the concrete Supplier is required to achieve.
7. Ratio of weight of fine aggregate to weight of coarse aggregate shall not be less than 0.50.
8. The amount of mid-range water reducing admixture (MRWR) added shall be approximately 3 to 12 ounces per 100 pounds of cement, to achieve specified slump.
9. The amount of high range water reducing admixture (HRWR) added shall be approximately 12 ounces per 100 pounds of cement, to achieve specified slump.
10. Ground granulated blast furnace slag (GGBFS) may be substituted for fly ash, if fly ash is not available.

END OF SECTION 03 31 00

SECTION 04 20 00 – MASONRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mortar and grout.

B. Reinforcement and anchorage.

C. Flashings.

D. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 04 42 00 - Exterior and Interior Stone Cladding: Stone Cladding.

B. Section 05 40 00 - Cold-Formed Metal Framing: Steel framing members supporting stone.

C. Section 07 27 00 - Air / Vapor Barriers: Applied Air / Vapor Barriers.

D. Section 07 62 00 - Sheet Metal Flashing and Trim: Through wall flashings and flashings at caps, lintels, and sills.

E. Section 07 92 00 - Joint Sealants: Sealing expansion joints.

1.3 REFERENCE STANDARDS

A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023.

B. ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2023.

C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

E. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

G. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

H. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.

I. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

J. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

K. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.

L. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

M. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.

N. BIA Technical Notes No. 28B - Brick Veneer/Cold-Formed Steel Framed Walls; 2025.

O. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.

P. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata.

1.4 SUBMITTALS

A. Product Data: Provide data for fabricated wire reinforcement, mortar, and stone accessories.

1.5 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

1.6 MOCK-UPS

A. Construct stone wall mock-up, 8 feet long by 6 feet high, including stone anchor accessories, sill and head flashings, window frame, corner condition, typical expansion joint, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up.

B. Approved mock-up will become standard for appearance and workmanship.

C. Mock-up may remain as part of work.

D. If mock-up is not incorporated into the work, remove and dispose of debris.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store stone units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1 MORTAR AND GROUT MATERIALS

A. Portland Cement:
   1. ASTM C595, Type 1L or Type 1L(10).
   2. ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
   3. Color: As required to produce approved color sample.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Aggregate: ASTM C144.

D. Grout Aggregate: ASTM C404.

E. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.

F. Water: Clean and potable.

G. Admixtures: Do not use admixtures without preapproval of Engineer.

H. Packaged Dry Material for Mortar for Stone Cladding: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
   1. Color: Standard gray.

I. Packaged Dry Material for Grout for Stone Cladding: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
   1. Type: Fine.

J. Mortar Color:
   1. Stone Cladding: Basis of Design: Solomon Colors, SGS Concentrated Mortar Colors, 60H White.

2.2 REINFORCEMENT

A. Horizontal Joint Reinforcement: ASTM A951/A951M.
   1. Type: Ladder.
   2. Material: stainless steel complying with ASTM A580/A580M Type 304.
   3. Size: 0.1875 inch side rods with 0.1875 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.

2.3 FLASHINGS

A. Through Wall Flashings; Stainless Steel, as indicated in Division 07, Sheet Metal Flashing and Trim.

B. Termination Bars: Stainless steel; compatible with membrane and adhesives.
   1. Manufacturers:
      a. Hohmann & Barnard, Inc.
      b. York Manufacturing, Inc.
      c. WIRE-BOND.

C. Flashing and Drip Edge Corners: Prefabricated inside and outside stainless steel corners and end dams, profile to match flashing and flashing drip edge.

D. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with air/vapor barrier membrane and adhesives.

2.4 ACCESSORIES

A. Thermal Block: A high-performance unit engineered with a cellular or multi-layer structure to minimize thermal conductivity and prevent heat transfer.
   1. Ultimate Compressive Strength: 1,300 psi per ASTM D1621.
   2. Thermal Conductivity: 0.47 BTU / in. / hr. /ft² / °F maximum per ASTM C518.

3. Manufacturers:
   a. Basis of Design: Thermal Bridging Solutions; Thermoblock.
   b. Fabreeka International Inc.
   c. General Plastics Manufacturing Company.

B. Joint Filler: Closed cell closed cell neoprene; oversized 50 percent to joint width; self expanding; in maximum lengths available.
   1. Manufacturers:
      a. Hohmann & Barnard, Inc.
      b. WIRE-BOND.

C. Bond Breaker: 10 mil (0.25 mm) thick plastic sheet.

D. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
      a. Manufacturers:
         1) Advanced Building Products, Inc; Mortar Break DT.
         2) Mortar Net Solutions; MortarNet.
         3) York Manufacturing, Inc; Weep-Net.

E. Weeps:
   1. Type: Molded PVC grilles, insect resistant.
   2. Color(s): As selected by Architect from manufacturer's full range.
   3. Manufacturers:
      a. Hohmann & Barnard, Inc: QV-Quadro-Vent.
      b. Mason Pro: Cell Vent

F. Cavity Vents:
   1. Type: Molded PVC grilles, insect resistant.
   2. Color(s): As selected by Architect from manufacturer's full range.
   3. Manufacturers:
      a. Hohmann & Barnard, Inc: QV-Quadro-Vent.
      b. Mason Pro: Cell Vent

G. Cleaning Solution: Non-acidic, not harmful to stone work or adjacent materials.

2.5 MORTAR AND GROUT MIXING

A. General: Do not use admixtures, unless otherwise indicated.
   1. Use of calcium chloride, for any purpose, is explicitly prohibited.
   2. Limit cementitious materials in mortar for exterior stone cladding to portland cement and lime.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Stone Cladding: ASTM C270, using the Property Specification.
   1. Stone Cladding below grade and in contact with earth: Type S.
   2. Exterior, stone cladding: Type N.
   3. Interior, stone cladding: Type N.
   4. Tuckpointing Mortar, Exterior and Interior: Type O.

C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

D. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

E. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

F. Mixing: Use mechanical batch mixer and comply with referenced standards.

2.6 LINTELS

A. Steel Lintels: As indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to masonry accessories.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into stone work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of stone work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Refer to Division 04, Exterior and Interior Stone Cladding.

3.4 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain stone courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
   1. Stone Cladding:
      a. Bond: As indicated on Drawings.
      b. Mortar Joints: Refer to Division 4 Section Exterior and Interior Stone Cladding.

3.5 PLACING AND BONDING

A. Lay stone units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar and mortar smears as work progresses.

D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

E. Interlock intersections and external corners. Provide stone exterior joint profile as indicated in Division 4 Exterior and Interior Stone Cladding.

F. Do not shift or tap stone units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of stone units with proper tools to provide straight, clean, unchipped edges. Prevent broken stone unit corners or edges.

H. Isolate stone partitions from vertical structural framing members with a expansion joint as indicated on Drawings.

I. Isolate top joint of stone partitions from horizontal structural framing members as indicated on Drawings.

3.6 THERMAL BLOCK

A. Install thermal block on foundation wall under stone cladding full width of wall cavity as indicated on Drawings.

B. Install thermal block per manufacturer's instructions.

3.7 WEEPS/CAVITY VENTS

A. Install weeps in cavity walls at every head joint horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

B. Install cavity vents in cavity walls at every head joint horizontally near top of walls.

3.8 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.9 REINFORCEMENT

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

B. Place stone joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.

E. Lap joint reinforcement ends minimum 6 inches.

3.10 FLASHINGS

A. Install flashing material as indicated in Division 7 Section Sheet Metal Flashing and Trim.

B. General:
   1. Prepare stone and adjacent surfaces so they are smooth and free from projections that could puncture flashing.
   2. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar.
   3. Before covering with mortar, seal penetrations in flashing as recommended by flashing manufacturer.

C. Whether or not specifically indicated, install flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent stone or turn up flashing ends (end dam) at least 2 inches, minimum, to form watertight pan at non-stone construction.
   2. At lintels and shelf angles, extend flashing a minimum of 6 inches into stone at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
   3. Remove or cover protrusions or sharp edges that could puncture flashings.
   4. Seal lapped ends and penetrations of flashing before covering with mortar.

D. Terminate flashing up 8 inches minimum on vertical surface of backing:
   1. Install vertical leg of flashing over air/vapor barriers over backing or per manufacturer’s directions. Apply air/vapor barrier tape / seal vertical leg of flashing.
   2. Anchor vertical leg of flashing into backing with a termination bar and sealant.

E. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

F. Extend metal flashings to exterior face of stone and provide an angled drip with hemmed edge.
   1. Within 8-feet of grade, omit angled drip and provide vertical drip with hemmed edge as indicated on Drawings.

G. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.11 LINTELS

A. Install loose steel lintels over openings.

3.12 GROUTED COMPONENTS

A. Place and consolidate grout fill without displacing other building elements.

3.13 EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through expansion joints.

B. Size expansion joints as indicated on drawings; if not indicated, 3/8 inch wide and deep.

C. Locate expansion joints as indicated on Drawings and in accordance with Brick Industry Association (BIA) Technical Notes.

3.14 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

D. Do not build into stone construction organic materials that are subject to deterioration or other foreign debris.

3.15 TOLERANCES

A. Refer to Division 04, Exterior and Interior Stone Cladding.

3.16 CUTTING AND FITTING

A. Cut and fit for pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape, and location. Maximum tolerance of opening around penetration, 1/4 inch.

B. Obtain approval prior to cutting or fitting stone work not indicated or where appearance or strength of stone work may be impaired.

3.17 TUCKPOINTING

A. Refer to Division 04, Exterior and Interior Stone Cladding.

3.18 CLEANING

A. Refer to Division 04, Exterior and Interior Stone Cladding.

3.19 PROTECTION

A. Refer to Division 04, Exterior and Interior Stone Cladding.

END OF SECTION

SECTION 04 42 00 - EXTERIOR AND INTERIOR STONE CLADDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cut dolomitic limestone veneer at exterior and interior walls.

B. Metal anchors and supports.

C. Sealing exterior joints.

D. Pointing of exterior and interior joints.

1.2 RELATED REQUIREMENTS

A. Section 04 20 00 – Masonry Accessories. Stone mortar, grout, reinforcement and accessories.

B. Section 05 40 00 - Cold-Formed Metal Framing: Steel framing members supporting stone.

C. Section 07 62 00 - Sheet Metal Flashing and Trim: Through wall flashings and flashings at copings, lintels, and sills.

D. Section 09 30 00 – Tiling: Cementitious backer board as an interior substrate for stone cladding.

1.3 REFERENCE STANDARDS

A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023.

B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

C. ASTM C119 - Standard Terminology Relating to Dimension Stone; 2026.

D. ASTM C568/C568M - Standard Specification for Limestone Dimension Stone; 2022.

E. ASTM C1528/C1528M - Standard Guide for Selection of Dimension Stone; 2020, with Editorial Revision (2025).

F. ILI (HB) - Indiana Limestone Handbook; 2007.

G. NBGQA (SPEC) - Specifications for Architectural Granite, Version 20-1; 2020.

H. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.

1.4 SUBMITTALS

A. Product Data: Provide data on stone, mortar products, and sealant products.

B. Shop Drawings: Indicate layout, pertinent dimensions, anchorages, head, jamb, and sill opening details, and jointing methods.

C. Samples: Submit three stone samples, 6 inch by 6 in size, illustrating each color range and texture, markings, and surface finish. Sample will be retained at Architect's office and not returned to Contractor.

D. Samples: Submit mortar color samples.

E. Installation Instructions: Submit stone fabricator's installation instructions and field erection or setting drawings; indicate panel identifying marks and locations on setting drawings.

F. Designer's Qualification Statement.

G. Stone Fabricator's Qualification Statement.

H. NSI Installer Qualification: Documentation of Natural Stone Institute Accreditation.

I. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

1.5 QUALITY ASSURANCE

A. Design anchors and supports under direct supervision of a Professional Structural Engineer, registered in the State in which the Project is located.
   1. Design anchors to resist positive and negative wind pressures and other loads as required by applicable code.
   2. Design anchor attachment to stone with a factor of safety of 5:1.
   3. Design each individual anchor with a factor of safety in the vertical dead-load-bearing direction of 4:1 and in the horizontal lateral-load-bearing direction of 3:1.

B. Perform work in accordance with ILI Indiana Limestone Handbook.

C. Perform work in accordance with NSI (DSDM).

D. Stone Fabricator: Company specializing in fabricating cut stone with minimum ten years of documented experience.

E. Installer Qualifications: Natural Stone Institute (NSI) Accredited Commercial A Contractor (heavy commercial); www.naturalstoneinstitute.org/#sle.

1.6 MOCK-UP

A. Construct stone wall mock-up, 8 feet long by 6 feet high, including stone anchor accessories, sill and head flashings, window frame, corner condition, typical control joint, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up.

B. Approved mock-up will become standard for appearance and workmanship.

C. Mock-up may remain as part of the Work.

D. If mock-up is not incorporated into the work, remove and dispose of debris.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store stone panels vertically on edge, resting weight on panel edge.

B. Protect stone from discoloration.

1.8 FIELD CONDITIONS

A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

1.9 SPECIAL BUILDING ENCLOSURE WARRANTY

A. Installer Warranty for Stone Cladding: Installer of stone cladding to provide 2-year material and labor warranty for tuckpointing of mortar joints, commencing on date of substantial completion. The warranty to include tuckpointing of all damaged and / or deteriorating mortar joints in both exterior and interior stone cladding.

PART 2 PRODUCTS

2.1 STONE

A. Dolomitic Limestone: complying with ASTM C568/C568M Classification III - High Density.
   1. Color: Greige (gray-beige) base with soft buff and beige marbling.
   2. Grain / Vain Direction: Vertical.
   3. Surface Finish: Brushed; as described in ASTM C119 and ASTM C1528/C1528M.
   4. Blend: Random blend. Do not pull more than 3 units from a single pallet at a time.
   5. Acceptable Producers:
      a. Basis of Design: EarthWorks, Gabouri Light and Gabouri Dark. Provide a ratio of 60 percent Gabouri Light and 40 percent Gabouri Dark.

2.2 MORTAR AND GROUT

A. Mortar: As specified in Division 4 Unit Masonry.

B. Grout: As specified in Division 4 Unit Masonry.

2.3 ANCHORS AND ACCESSORIES

A. Anchors and Other Components in Contact with Stone: Stainless steel, ASTM A666 Type 304.
   1. Sizes and configurations: As indicated in Drawings and as required for vertical and horizontal support of stone and applicable loads.
   2. Wire ties are not permitted.

B. Support Components not in Contact with Stone: Stainless steel, ASTM A240/A240M Type 304.

C. Reinforcement: Provide complying with Division 4 Unit Masonry.

D. Setting Buttons and Shims: Plastic type.

E. Weep/Cavity Vents, Joint Filler, Bond Breaker: Provide complying with Division 4 Unit Masonry.

F. Joint Sealant and Backer Rod: Provide complying with Division 7 Section Joint Sealants.

G. Scratch Coating: Cementitious parging of mortar to a minimum thickness as required to set stone at interior adhered locations only.

H. Back Coating:
   1. Cementitious parging of mortar to a minimum thickness of 1/2 inch at interior adhered locations only.
   2. Bituminous damp proofing at exterior units below grade or where cavity behind unit is grouted solid.

I. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.

2.4 STONE FABRICATION

A. Thickness: As indicated on Drawings.

B. Panel Size: As indicated on drawings.

C. Fabrication Tolerances: In accordance with NSI (DSDM).

D. Fabricate units for uniform coloration between adjacent units and over the full area of the installation.

E. Corners: Form external corners both exterior and interior to a quirk joint profile.

F. Slope exposed top surfaces of stone and horizontal sill surfaces for natural wash.

G. Cut drip slot in bottom surface of work projecting more than 1/2 inch over wall openings. Size slot not less than 3/8 inch wide and 1/4 inch deep; full width of projection.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that support work and site conditions are ready to receive work of this section.

B. Verify that items built-in under other sections are properly located and sized.

3.2 PREPARATION

A. Clean stone prior to erection. Do not use wire brushes or implements that will mark or damage exposed surfaces.

B. Scratch coat: Install cementitious scratch coat over interior substrate 48 hours minimum prior to stone installation.

C. Coat back surfaces with back coating at interior locations only.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.4 INSTALLATION

A. Install flashings as indicated in Division 04, Unit Masonry and Division 07, Section Sheet Metal Flashing and Trim.

B. Installed reinforcement and accessories as indicated in Division 04, Unit Masonry.

C. Erect stone in accordance with stone supplier's instructions and erection drawings.

D. Set stone with a consistent joint width of 3/8 inch.

E. Install anchors and place setting buttons to support stone and to establish joint dimensions.

F. Joints in Exterior Work: Seal joints with joint sealant over backer rod, following sealant manufacturer's instructions; tool sealant surface to concave profile.

G. Joints in Interior Work: Leave perimeter joints open for sealant; fill other joints with pointing mortar; pack and work into voids; tool surface to concave joint.

3.5 TOLERANCES

A. Install stone within the site tolerances found in TMS 402/602.

B. Positioning of Elements: Maximum 1/4 inch from true position.

C. Maximum Variation from Alignment of Columns: 1/4 inch.

D. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet; 1/2 inch in 50 feet.

E. Maximum Variation Between Face Plane of Adjacent Panels: 1/16 inch.

F. Maximum Variation from Plumb: 1/4 inch.

G. Maximum Variation from Level Coursing: 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch maximum.

H. Maximum Variation of Joint Thickness:
   1. Head joint: minus 1/8 inch, plus or minus.
   2. Bed joint: 1/8 inch in 3 feet, not cumulative.

I. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.6 CUTTING AND FITTING

A. Obtain approval prior to cutting or fitting any item not so indicated on drawings.

B. Do not impair appearance or strength of stone work by cutting.

3.7 TUCKPOINTING

A. 28 days after installation of all exterior stone cladding, tuckpoint all mortar joints where mortar shrinkage has occurred.

B. 28 days after installation of all interior stone cladding, tuckpoint all mortar joints where mortar shrinkage has occurred.

C. Mortar as indicated in Division 04, Masonry Accessories.

D. Cut out loose or disintegrated mortar in joints to minimum 1/2 inch depth or until sound mortar is reached.

E. Do not damage stone units.

F. When cutting is complete, remove dust and loose material by brushing or air jet.

G. Premoisten joint and apply mortar. Pack tightly in maximum 1/4 inch layers. Form a smooth, compact concave joint to match existing.

H. Moist cure for 72 hours.

3.8 CLEANING

A. Remove excess joint material upon completion of work.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.9 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 12 00 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing, fabrication and erection of all structural steel, including the major items listed below:
   1. Base plates, setting plates and anchor rods for columns.
   2. Columns.
   3. Beams, girders, purlins.
   4. Edge angle.
   5. Angle frames.
   6. Bracing.
   7. Lintels if connected to structural steel columns.
   8. Shelf angles.
   9. Appurtenances, connections, bolts, plates for the above.
   10. All embedded items required for other portions of work.
   11. Other items as listed in Section 2.1 of AISC Code of Standard Practice for Steel Buildings and Bridges.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. A6 – General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling.
      b. A36 – Carbon Structural Steel.
      c. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      d. A108 – Carbon Steel Bars, Cold Finished, Standard Quality.
      e. A123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      f. A153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      g. A325 – Structural Bolts, Steel, Heat Treated, 120/105 ksi; Minimum Tensile Strength.
      h. A490 – Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.
      i. A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      j. A501 – Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
      k. A563 – Carbon and Alloy Steel Nuts.
      l. A572 – High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
      m. A780 – Standard Practice for Repair of Damaged and Uncoated Hot-Dip Galvanized Coatings.
      n. A992 – Steel for Structural Shapes for Use in Building Framing.
      o. F436 – Hardened Steel Washers.
      p. F1554 – Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
   2. AISC:
      a. Code of Standard Practice for Steel Buildings and Bridges (excluding Code of Standard Practice – Section 4.2.1).
      b. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
      c. Detailing for Steel Construction.
      d. Manual of Steel Construction.
      e. Specification for Structural Joints Using ASTM A325 or A490 Bolts.
   3. AWS – American Welding Society publications:
      a. ANSI/AWS D1.1 – Structural Welding Code – Steel.
   4. American Hot-Dip Galvanizers Association.

1.4 DEFINITIONS

A. Fabricator: An individual, firm or corporation that assembles raw structural steel items into structural steel building members.

1.5 CONNECTION DESIGN REQUIREMENTS

A. Fabricator:
   1. Responsible for the structural design of all connections between structural steel and structural steel except those specifically noted on the Drawings as Engineer designed.
   2. Responsible for the design of moment connections where indicated on the Drawings.
   3. Coordinate type of connection (bolted or welded) with steel erector.

B. General Types of Connections: Indicated on Drawings.

C. Design of Structural Steel to Structural Steel Connections:
   1. Equal to standard framing connections in accordance with AISC – Manual of Steel Construction.
   2. Minimum Load Connection:
      a. Two 3/4-inch diameter bolts, or
      b. Welds with a total capacity of 6,000 pounds.
   3. Beam connections shall be designed for a shear capacity equal to the greater of the following:
      a. 1/2 the total allowable uniform load capacity of the beam according to the AISC Manual of Steel Construction, Section 3, or
      b. The actual shear load due to combination of all loads as indicated on the Drawings.
   4. Connections: Bolted bearing type unless indicated otherwise on the Drawings.
   5. By a Registered Professional Engineer licensed to practice at the location of the Work.

1.6 SUBMITTALS

A. Shop Drawings: For all members to be furnished to include:
   1. Detail Drawings of Members and Connections:
      a. In accordance with AISC – Detailing for Steel Construction.
      b. Size, number and type of bolts.
      c. Dimensions.
      d. Connection angles and plates.
      e. Camber.
      f. Holes.
   2. Erection Drawings:
      a. Locate and identify members.
      b. Clearly identify bolt installation requirements.
   3. Welding: In accordance with AWS welding symbols.
   4. Type of paint.
   5. Items to be galvanized.
   6. Steel sections which are not available, and suggested steel sections that are available.

B. Certifications:
   1. Proof of acceptable quality control program, upon Engineer’s request.
   2. Bolts, Nuts and Washers: Manufacturer's certification that products supplied for this Project comply with this specification.
   3. Weld Filler Materials: Manufacturer's certification that products supplied for this Project comply with this specification.

C. Mill Certification Tests: Submit in compliance with the Building Code.

D. Provide setting Drawings, templates and directions for the installation of anchor rods and other devices.

1.7 QUALITY ASSURANCE

A. Fabrication and Erection Personnel Qualifications:
   1. Trained and experienced in the type of work being performed.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Welders, Welding Operators and Tackers Qualifications:
   1. Qualified by tests in accordance with AWS D1.1.
   2. Qualification Papers:
      a. Given by an independent testing laboratory.
      b. Dated no earlier than 6 months prior to beginning of Project.
   3. Engineer, at Engineer's discretion, may accept evidence of previous qualifications.

C. Steel Fabricators Qualifications:
   1. Certified under the AISC Quality Certification Program for Category I – Conventional Steel Structures, or under other quality control program acceptable to building official in accordance with building code, prior to fabrication.
   2. The quality control program shall permit work on fabricator's premises without special inspection.

D. Special Inspection of Welds, Bolts and Headed Studs: In accordance with Division 01 Section "Special Inspections and Tests."

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, unload, handle and store structural steel items in such manner as to not distort or otherwise damage the materials, and protect from corrosion and deterioration.

B. Reject damaged, deteriorated or distorted material and immediately remove from the Site. Replace rejected materials with new material at no additional cost to Owner.

C. Embedded Items:
   1. Includes anchor rods and other anchorage devices which are to be embedded in cast-in-place concrete and masonry.
   2. Deliver to the Project Site before the start of cast-in-place concrete and masonry operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: All materials shall be subject to Engineer's review.

B. Structural Steel:
   1. All Structural Steel Shapes:
      a. New, unused and perfect stock.
      b. Free from millscale, rust, flake, pitting and imperfections.
      c. Without bends, kinks and distortions.
   2. Identified Steel Sizes:
      a. Review availability of specified steel sizes for delivery within the project schedule.
      b. Submit to Engineer proposed alternative sizes, if specified sizes are unavailable.
      c. Be responsible for additional costs, if any, of steel size revisions required because of availability or project schedule.
   3. Shop splicing of members will be permitted only if the member exceeds maximum mill length or if approved by Engineer and so indicated on the Drawings.
   4. Steel:
      a. Wide Flange and WT Shapes: ASTM A992.
      b. M, S, MT and ST Shapes; Channels, Angles, Bars, Plates and Rods: ASTM A36, with yield stress of 36,000 psi.
      c. Square and Rectangular Tubular Shapes: ASTM A500, Grade C, with yield stress of 50,000 psi.

C. Bolted Connections:
   1. Bolts:
      a. ASTM A325, 3/4-inch diameter or larger unless indicated otherwise on the Drawings.
      b. ASTM A490, 3/4-inch diameter or larger, only if required by connection design.
   2. Nuts: ASTM A563, overtapped when used on galvanized bolts.
   3. Washers:
      a. ASTM F436, Type I.
      b. Circular, clipped, or beveled as required by the application.

D. Welding:
   1. In Accordance With:
      a. AISC Specification.
      b. AWS Structural Welding Codes D1.1.
   2. Filler Metal: As indicated in AWS D1.1.

E. Prime Paint: As specified in Division 09.

F. Anchor Rods:
   1. ASTM F1554, Grade 36.
   2. Remove all oil, grease and dirt from anchor rods prior to shipping to the Site.
   3. Anchor Rod Washers:
      a. 5/16-inch ASTM A36 plate.
      b. With hole 1/16-inch larger than anchor rod diameter.

2.2 FABRICATION

A. Shop Assembly:
   1. Assemble steel work in shop by bolting and welding, as indicated on Drawings and as herein specified.
   2. Assemble components prior to shipping as much as is practical.
   3. Camber steel beams to amounts indicated on the Drawings.
   4. Fabricate and ship steel in sequence which minimizes rehandling of steel and expedites erection.
   5. Accurately mill ends of columns and other members to be in direct bearing.

B. Fabrication:
   1. Conform to Applicable Portions of AISC:
      a. Specification for the Design, Fabrication, and Erection of Structural Steel for Building.
      b. Code of Standard Practice (excluding Code of Standard Practice – Section 4.2.1).

C. Holes:
   1. Provide all required holes for attachment of the work of other trades.
   2. Where conditions require, holes shall be slotted.
   3. Do not flame cut holes or enlarge holes by burning.

D. Galvanizing:
   1. Hot-dipped galvanize with 2.3 oz/ft^2 minimum after fabrication in accordance with ASTM A123, unless noted otherwise.
   2. Hot-dip galvanize bolts, nuts, washers and anchor rods in accordance with ASTM A153, Class C.
   3. Galvanize the following items:
      a. Items so indicated on the Drawings.
      b. Bolts, nuts and washers for connections within enclosed but unconditioned spaces, including canopies and above colonnades.

E. Architecturally Exposed Structural Steel:
   1. Includes the following specific members:
      a. HSS members supporting tops of Nanawall exterior foldable partitions.
   2. Fabricate with exposed surfaces smooth and free of pittings, rust, trade names or other stamped data, and other similar surface defects.
   3. Remove or repair surface defects prior to shop painting.
   4. Comply with AISC Code of Standard Practice for Architecturally Exposed Structural Steel.

2.3 SHOP PAINTING

A. Surface preparation and prime painting: As specified in Division 09.

B. Prime Paint:
1. Hold paint back on all surfaces which are:
   a. Enclosed in concrete.
   b. Within 2 inches of field weld areas or slip-critical bolted connections.
   c. To be spray fireproofed.
   d. To be galvanized.
2. Surfaces not accessible after assembly shall be painted before assembly.
3. Work paint into all joints.
4. Thoroughly dry before shipment.
5. Smooth, even, free from skips and runs.
6. Suitable to receive field painting finish coats.

C. Identification: Paint each item in shop with identification mark in accordance with erection drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Survey:
1. Check elevations of bearing surfaces and locations of anchor rods and embedded connections.
2. Report discrepancies to Engineer.
3. Do not proceed with erection until Engineer has reviewed discrepancies and adjustments have been agreed upon.

3.2 ERECTION

A. Assembly:
1. Erect steel accurately to lines and elevations indicated.
2. Align and adjust framing as erection proceeds and before final fastening.
3. Splice members only where so indicated on the reviewed Shop Drawings.
4. Remove erection bolts and connections where required for exposed construction; plug weld holes and grind all exposed surfaces smooth.
5. Remove mud, tags, and other foreign material from members prior to erection.

B. Thermal Changes:
1. When erecting steel, make allowances for changes of member lengths due to changes in temperature between erection and Substantial Completion.
2. When plumbing columns and struts, generally:
   a. Set columns at the center of building plumb.
   b. Cant exterior columns in or out depending upon temperature at time of erection.

C. Temporary Bracing:
1. Provide temporary bracing and accessories required for complete erection.
2. Safety and adequacy of temporary bracing is the responsibility of Contractor.
3. Structure will not be stable until all beams, floors, roofs, shear walls and bracing are complete.

D. Burning of holes is prohibited.

E. Cutting:
1. Gas cutting is prohibited on major members.
2. On minor members not stressed: Obtain Engineer's prior approval.

F. Do all cutting, fitting, drilling and tapping of materials as required for proper and complete installation of work of this Section.

G. Tightening:
   1. Tighten bolts snug-tight as defined by AISC, unless otherwise noted on the Drawings.
   2. Tighten bolts in slotted holes using AISC Turn-of-the-Nut Method, unless indicated otherwise on the Drawings; or approved by Engineer.
   3. Where specifically indicated on the Drawings, finger-tighten nuts in connections where movement must be permitted, and tighten jam nut over finger-tightened nut, or peen bolt threads, to prevent nut backoff.

H. Welding: Field welding shall be performed to the same standards and requirements as shop welding.

I. Touch Up:
   1. After erection is complete, touch up all shop priming coats damaged during transportation and erection.
   2. Prime all field welds, bolt heads, nuts and abrasions using the priming paint specified for shop priming.
   3. Touch up all damaged galvanized areas with a zinc rich paint meeting ASTM A780.

J. Erection Tolerances:
   1. Structural Steel: In accordance with AISC Code of Standard Practice.
   2. Architecturally Exposed Structural Steel: In accordance with AISC Code of Standard Practice.

3.3 CLEANING

A. Prior to acceptance of the work of this Section, thoroughly clean all structural steel and related areas in accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 05 12 00

SECTION 05 30 00 – METAL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the furnishing and installation of metal decking and accessories.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. American Society for Testing and Materials (ASTM) Standard Specifications:
      a. A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, Structural (Physical) Quality.
      b. A924 – Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
      c. A780 – Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      d. D520 – Zinc Dust Pigment for Paint.
   2. American Institute Steel Construction (AISC) publications:
      a. Steel Construction Manual.
   3. American Iron and Steel Institute (AISI) publications:
      a. Specification for the Design of Cold-Formed Steel Structural Members.
   4. Steel Deck Institute (SDI) publications:
      a. Design Manual for Composite Decks, Form Decks and Roof Decks.
      b. Diaphragm Design Manual.
      c. Roof Deck Specification.

1.4 SUBMITTALS

A. Shop Drawings: For metal decking to include:
   1. Sizes, profiles and lengths.
   2. Locations.
   3. Details of erection.
   4. Type of finish.

B. Certification: Furnish a mill certification or laboratory test data verifying that yield strength and metal thicknesses comply with these Specifications, if requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect decking with coverings while in transit and while stored at Site.
   1. Allow adequate air movement beneath coverings.
   2. Provide blocking under stored decking to:
      a. Provide sloped drainage.
      b. Keep decking off ground.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
1. Materials shall comply with one or more of the following:
a. Galvanized Deck:
1) ASTM A653, Grade SS.
2) ASTM A924, G60.

B. Roof Deck:
1. Type and Size: As indicated on the Drawings with nesting type side lap.
2. Galvanized.

2.2 FABRICATION

A. Fabricate to obtain continuity over as many spans as practicable.

B. Acoustical Deck: Glue or fasten fiberglass inserts in place prior to shipment to Site.

PART 3 - EXECUTION

3.1 ERECTION

A. General
1. Erect decking and weld to supports in accordance with Manufacturer's specifications, as herein specified and as indicated on the Drawings.
2. Install decking in conformance with UL design numbers as indicated on the Drawings.
3. Field cutting of openings through the deck shall be less than 16 square feet in area. Perform skew cutting in the field.
4. Touch up field welds on the top surface of deck and damaged areas with paint similar to specified deck finish.
5. Touch up damaged galvanized areas with a zinc rich paint meeting ASTM D520 and ASTM A780.

B. Roof Deck:
1. Anchoring:
a. With anchors as indicated on the Drawings to all steel supporting members.
b. Anchor Pattern: As indicated on the Drawings.
2. Side Laps:
a. Fasten with screws as indicated on the Drawings.
b. Fastener Spacing: As indicated on the Drawings.
3. Side Termination of Roof Deck: At edges of roof and at openings in roof deck where a structural steel supporting member occurs, the bottom of a flute shall occur and bear on one of the following:
a. Supporting steel member.
b. A Channel Shaped 18 Gage Member:
1) Connected to both the metal deck and the steel supporting member below with the same connection type and spacing as indicated for anchoring deck to structural members.
2) The channel depth shall match the metal roof deck depth.
3) The length of the horizontal legs of the channel shall be as required to obtain bearing.
4. Span Direction Changes of Roof Deck: Where roof deck changes direction of span, and there is no provision in the structure for an expansion joint, reinforce the discontinuity at the joint with an 9-inch wide, 20 gage, flat plate fastened to both sides of the joint with No. 12 self-tapping screws, 6 inches on center.

3.2 CLEANING

A. Prior to acceptance of the work of this Section, thoroughly clean deck and affected areas in accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 05 30 00

SECTION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the design, furnishing and installation of cold-formed metal framing, and the major items listed below:
   1. Exterior wall framing.
   2. Interior load bearing wall framing.
   3. Floor joist framing.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. A36 – Carbon Structural Steel.
      b. A123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      c. A153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      d. A570 – Specification for Steel, Sheet and Strip, Carbon, Hot Rolled, Structural Quality.
      e. A611 – Specification for Steel, Sheet, Carbon, Cold-Rolled, Structural Quality.
      f. A653 – Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
      g. A780 – Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      h. C150 – Portland Cement.
      i. C404 – Aggregates for Masonry Grout.
      j. C954 – Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033-in. to 0.112-in. in Thickness.
      k. C955 – Load Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases.
      l. C1007 – Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
      m. D520 – Zinc Dust Pigment.
      n. E119 – Test Methods for Fire Tests of Building Construction and Materials.
      o. E488 – Test Methods for Strength of Anchors in Concrete and Masonry Elements.
      p. E1190 – Test Methods for Strength of Powder-Actuated Fasteners Installed in Structural Members.
      q. F1554 – Anchor Bolts, Steel, 36-, 55-, and 105-ksi Yield Strength.
   2. American Iron and Steel Institute (AISI) publications:
      a. Specification for the Design of Cold-Formed Steel Structural Members.
   3. American Welding Society (AWS) Standards:
      a. AWS D1.1 – Structural Welding Code – Steel.
      b. AWS D1.3 – Structural Welding Code – Sheet Steel.
   4. Center for Cold-Formed Steel Structures (CCFSS):
      a. Technical Bulletin: AISI Specification Provisions for Screw Connections.

1.4 DEFINITIONS

A. Terms:
   1. Load Bearing:
      a. An application in which the member is subjected to one or both of the following:
         1) Lateral loads exceeding 5 psf.
         2) Vertical loads exceeding 200 pounds.

b. All exterior wall members are load bearing members.
2. Non-Load Bearing:
a. All applications other than load bearing.
b. In accordance with Division 09 Section “Gypsum Board Assemblies.”

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Minimum Requirements:
1. Framing sizes and connection details, if any, indicated on the Drawings are minimum requirements.
2. Use larger sizes or stronger details, and add members and connections, if required as a result of Contractor’s design at no additional cost to Owner.
3. Notify Engineer of member size change requirements prior to installation.

B. Structural Performance:
1. Design framing system and connections capable of withstanding design loads within limits and under conditions indicated.
2. Design Loads:
a. Dead Loads: Actual weights of materials and fixed equipment, as calculated by designer.
b. Floor Live Loads: 40 psf.
c. As indicated on Drawings.
3. Design framing system to withstand design loads without deflections greater than the following:
a. Exterior Wall Framing: Horizontal deflection of 1/600 of the wall height.
b. Interior Load-Bearing Wall Framing: Horizontal deflection of l/240 of the wall height.
c. Floor Framing: Vertical deflection of 1/360 of the horizontally projected span.
4. Design framing system and connections to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subjected to a maximum ambient temperature change of 120 degrees F.
5. Design framing system and connections to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary structure as follows:
a. Upward and downward movement of 1-inch.

C. Design exterior wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.6 SUBMITTALS

A. Submit for each type of cold-formed metal framing product and accessory to be used in construction.

B. Shop Drawings to include the following:
1. Special components and installations not fully dimensioned or detailed.
2. Include placing drawings for framing members showing material, shop coatings, size and gage designations, number, type, location, and spacing.
3. Indicate strapping, bracing, splices, bridging, accessories, details of fabrication, details of attachment to adjoining work, location and spacing of fasteners for attaching framing to itself, and critical installation procedures.

C. Certification:
1. Furnish a mill certification signed by steel sheet producer indicating that steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, elongation, chemical requirements, and galvanized coating thickness.
2. Furnish copies of welding certificates for welding procedures and personnel.

1.7 QUALITY ASSURANCE

A. Installer Qualification: Engage experienced installer who has completed cold-forming metal framing similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Welding: Use AWS qualified welders and comply with AWS D1.1 and D1.3 requirements.

C. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for fire resistive rating, including those required for compliance with governing regulations, provide units that have been tested for fire resistance in accordance with ASTM E119 and are acceptable to governing authorities having jurisdiction.

D. Pre-Installation Conference:
   1. Prior to start of installation of metal framing systems, meet at Project Site with installers of other work including door and window frames and mechanical and electrical work.
   2. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Dale Industries, Inc., Dearborn, MI.
   2. Dietrich Industries, Inc., Hammond, IN.
   3. Marino/Ware Industries, Inc., South Plainfield, NJ.
   4. Super Stud Building Products, Inc., Astoria, NY.
   5. Unimast Corporation, Schiller Park, IL.

2.2 MATERIALS

A. Galvanized Steel Sheet:
   1. ASTM A653, structural steel, zinc coated.
   2. Grade 33 for minimum uncoated thickness of 0.0428-inch and less and Grade 50 for minimum uncoated steel thickness of 0.0538-inch and greater.
   3. Coating: G60.

B. Painted Steel Sheet:
   1. ASTM A570 hot-rolled or ASTM A611 cold-rolled.
   2. Cleaned, pretreated, and primed with Manufacturer's baked-on lead-free and chromate-free, rust inhibitive primer complying with performance requirements in Fed Spec. TT-P-664.
   3. Grade 33 or C, Type 1 or 2, for minimum uncoated steel thickness of 0.0428-inch and less and Grade 40 or D, Type 1 or 2, for minimum uncoated steel thickness of 0.0538-inch and greater.

2.3 LOAD BEARING FRAMING

A. Steel Studs and Joists:
   1. Manufacturer's standard C-shaped steel studs, of web depths indicated or otherwise required, punched, with stiffened flanges, complying with ASTM C955.
   2. Minimum Uncoated Steel Thickness: 33 mils (0.0329-inch).
   3. Minimum Flange Width: 1-5/8 inches.

B. Steel Track:
   1. Manufacturer's standard U-shaped steel track, of web depths indicated or otherwise required, unpunched, with straight flanges, complying with ASTM C955.
   2. Minimum Uncoated Steel Thickness: 33 mils (0.0329-inch).
   3. Minimum Flange Width: 1-1/4 inches.

2.4 FRAMING ACCESSORIES

A. Fabricate steel framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.

B. Provide accessories of Manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. End clips.
   5. Foundation clips.
   6. Gusset plates.
   7. Stud kickers, knee braces, and girts.
   8. Joist hangers and end closures.
   9. Hole reinforcing plates.
   10. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Clips: ASTM A36 steel shapes, zinc coated by the hot-dip process in accordance with ASTM A123.

B. Anchor Rods:
   1. ASTM F1554, Grade 36 threaded carbon steel rods and carbon steel nuts, and flat, hardened steel washers, zinc coated by the hot-dip process in accordance with ASTM A153.
   2. Provide hex head, headless hooked, or headless with encased end threaded bolts as indicated.

C. Expansion Anchors:
   1. Fabricated from corrosion resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing in accordance with ASTM E488 conducted by a qualified independent testing agency.
   2. Hilti; Powers/Rawl; or equal.

D. Powder Actuated Fasteners: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing in accordance with ASTM E1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners:
   1. Corrosion-resistant coated, self-drilling, self-threading steel drill screws in accordance with ASTM C954.
   2. Head Type: Low-profile head beneath sheathing, Manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: Minimum 90% zinc- rich coating in conformance with ASTM D520 and applied in accordance with ASTM A780.

B. Cement Grout:
   1. Portland Cement: ASTM C150, Type I.
   2. Sand: Clean, natural, ASTM C404.
   3. Mix cement and sand at ratio of 1 part cement to 2-1/2 parts sand by volume, with minimum potable water required for workability and hydration.

C. Plywood Sheathing and Accessories: In accordance with Division 06 Section "Rough Carpentry."

D. Insulation and Accessories: In accordance with Division 07 Section "Thermal Insulation."

E. Gypsum Sheathing and Accessories: In accordance with Division 09 Section “Gypsum Board Assemblies.”

2.7 SHOP FABRICATION

A. At Contractor’s option, portions of the cold-formed metal framing may be prefabricated and preassembled prior to installation at the Project Site.

B. Fabrication:
   1. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened in accordance with Manufacturer’s written recommendations and requirements of this Section.
   2. Fabricate framing assemblies using jigs or templates.
   3. Cut framing members by sawing or shearing; do not torch-cut.
   4. Fastening:
      a. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator; wire-tying is not permitted:
      b. Comply with AWS D1.3 requirements and procedures for welding, appearance, and quality of welds, and methods used in correcting welding work.
      c. Locate mechanical fasteners and install according to reviewed Shop Drawings, with screws penetrating joined members by not less than three exposed screw threads.

C. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses.

D. Lift fabricated assemblies to prevent damage or permanent distortion.

E. Fabrication Tolerances:
   1. Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8-inch in 10 feet:
   2. Space individual framing members no more than plus or minus 1/8-inch from plan location.
   3. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finish materials.
   4. Fabricate each cold-formed metal framing assembly to an out-of-square tolerance of 1/8-inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistive rating indicated.

C. Protect remaining fire-resistive materials from damage.

D. Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.

3.3 INSTALLATION

A. General:
1. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
2. Install cold-formed framing in accordance with ASTM C1007, unless more stringent requirements are indicated.
3. Install shop or field fabricated cold-formed framing and securely anchor to supporting structure.
4. Bolt or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16-inch.
5. Install cold-formed framing and accessories plumb, square, and true to line, and with connections securely fastened, in accordance with Manufacturer's written recommendations and requirements of this Section.
6. Cut framing members by sawing or shearing; do not torch cut.
7. Fasten framing members by welding or screw fastening. Wire tying is not permitted.
8. Comply with AWS D1.3 requirements and procedures for welding and correction of welding.
9. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members,
10. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed.
11. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
12. Do not bridge building expansion and control joints with cold-formed metal framing; independently frame both sides of joints.
13. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings that are inaccessible on completion of framing work.
14. Fasten hole reinforcing plate over web penetrations that exceed size of Manufacturer's standards punched openings.
15. Tolerances:
    a. Install framing level, plumb, and true to line to a maximum allowable variation of 1/8-inch in 10 feet.
    b. Space individual members no more than ± 1/8-inch from plan location.
    c. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

B. Walls:
1. Install continuous top and bottom tracks to match studs.
2. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
    a. Anchor Spacing: As indicated on the Drawings.
3. Squarely seat studs against webs of top and bottom tracks.
4. Fasten both flanges of studs to top and bottom tracks with stud spacings as indicated.
5. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.
6. Align studs vertically where wall-framing continuity is interrupted by floor framing. Where studs cannot be aligned, continuously reinforce track to transfer loads.
7. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
8. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
9. Headers:
    a. Install headers over wall openings wider than stud spacing.
    b. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
    c. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Drawings.
    d. Install runner tracks and jack studs above and below wall openings.
    e. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

10. Blocking:
    a. Install supplementary framing, blocking, and bracing in stud framing where indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
    b. If type of supplementary support is not indicated, comply with stud Manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
11. Bridging:
    a. Install horizontal bridging in stud system.
    b. Space bridging the dimension indicated on Drawings.
    c. Fasten at each stud intersection.
    d. Choose Either Of:
        1) Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of a clip angle.
        2) Combination of flat, taut steel sheet straps and stud track solid blocking of width and thickness to match studs. Fasten flat strap to stud flanges and secure solid blocking to stud webs or flanges.
12. Diagonal Bracing:
    a. Install steel sheet diagonal bracing straps to both stud flanges, terminate at, and fasten to reinforced top and bottom tracks.
    b. Fasten clip angle connectors to multiple studs at ends of bracing and anchor to structure.
13. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

C. Joists:
1. Track:
    a. Install perimeter joist track sized to match joists.
    b. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
2. Joist Bearing:
    a. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce.
    b. Fasten joists to both flanges of joist track.
    c. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
    d. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel stud sections as indicated on Shop Drawings.
3. Space joists not more than 2 inches from abutting walls, and generally 12 inches for exterior walls or 16 inches for interior walls thereafter.
4. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists.
5. Support Reinforcement:
    a. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on the Shop Drawings.
    b. Install web stiffeners to transfer axial loads of walls above.
6. Bridging:
    a. Install bridging at each end of joists and at intervals indicated on Shop Drawings.
    b. Choose 1 of the Following Methods:
        1) Cold-rolled steel channel, welded or mechanically fastened to bottom flange of joists.
        2) Joist-track solid blocking of width and thickness indicated, secured to joist webs.
        3) Combination of flat, taut, steel straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
7. Secure joists to load bearing interior walls to prevent lateral movement of bottom flange.
8. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

D. Sheathing: In accordance with Division 06 Section “Rough Carpentry” and Division 09 Section “Gypsum Board Assemblies.”

3.4 REPAIRS AND PROTECTION

A. Galvanizing Repair: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint in accordance with ASTM A780 and Manufacturer’s written instructions.

B. Touch-Up Painting:
   1. Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing.
   2. Paint framing surfaces with same type of shop paint used on adjacent surfaces.

C. Protection:
   1. Protect paper-surfaced gypsum sheathing that will be exposed to weather for more than 30 days by covering exposed exterior surface of sheathing with a securely fastened air-infiltration barrier.
   2. Apply covering immediately after sheathing is installed.
   3. Protect cutouts, corners, and joints in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing Manufacturer at time sheathing is installed.

D. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing, fabrication and erection of metal fabrications, including the major items listed below:
   1. Loose angle and wide flange lintels.
   2. Steel stairs and landings including posts, bearing plates and integral support beams.
   3. Bollards.
   4. Channel or bent plate door frames.
   5. Galvanizing of selected items.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the pertinent provisions of the following:
   1. ASTM Standard Specifications:
      a. A36 – Structural Steel.
      b. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      c. A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      d. A153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      e. A307 – Carbon Steel Bolts and Studs, 60,000 psi, Tensile Strength.
      f. A325 – Structural Bolts, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
      g. A366 – Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent), Cold-Rolled.
      h. A490 – Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.
      i. A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      j. A501 – Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
      k. A563 – Carbon and Alloy Steel Nuts.
      l. A780 – Standard Practice for Repair of Damaged Hot-Dip Galvanized Coatings.
      m. A786 – Rolled Steel Floor Plates.
      n. A992 – Steel for Structural Shapes for Use in Building Framing.
      o. B633 – Electro-deposited Coatings of Zinc on Iron and Steel.
      p. D520 – Zinc Dust Pigment for Paint.
      q. E488 – Strength of Anchors in Concrete and Masonry Elements.
      r. E1512 – Testing Bond Performance of Adhesive-Bonded Anchors.
      s. F436 – Hardened Steel Washers.
      t. F1267 – Expanded Metal, Steel.
      u. F1554 – Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
   2. AISC publications:
      a. Code of Standard Practice for Steel Buildings and Bridges (excluding Section 4.2.1).
      b. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
      c. Detailing for Steel Construction.
      d. Manual of Steel Construction.
      e. Specification for Structural Joints Using ASTM A325 or A490 Bolts.
   3. AWS publications:
      a. ANSI/AWS A5.1 – Carbon Steel Electrodes for Shielded Arc Welding.
      b. ANSI/AWS D1.1 – Structural Welding Code – Steel.
   4. ASME – American Society of Mechanical Engineers:
      a. ANSI/ASME B18.2.1 – Heavy Hex Structural and Askew Head Bolts.
      b. ANSI/ASME B18.6.1 – Wood Screws.

c. ANSI/ASME B18.6.3 – Slotted and Recessed Head Machine Screws.
d. ANSI/ASME B18.21.1 – Lock Washers.
e. ANSI/ASME B18.22.1 – Plain Washers.

5. Federal Specifications:
   a. FS FF-B-588C(1) – Bolt, Toggle, and Expansion Sleeve, Screw.
6. American Hot-Dip Galvanizers Association.
7. Occupational Safety and Health Act.
8. NAAMM – National Association of Architectural Metal Manufacturers.
9. The Aluminum Association.

1.4 SUBMITTALS

A. Shop Drawings: For all members to be furnished to include:
   1. Detail Drawings of Members and Connections:
      a. In accordance with AISC – Detailing for Steel Construction.
      b. Size and number of bolts.
      c. Dimensions.
      d. Connection angles and plates.
   2. Erection Drawings: Locate and identify members.
   3. Welding: In accordance with AWS welding symbols.
   4. Type of paint.
   5. Item to be galvanized.

B. Mill Certification Tests: Submit in compliance with Michigan Building Code.

C. Provide setting drawings, templates and directions for the installation of anchor bolts and other devices.

1.5 QUALITY ASSURANCE

A. Fabrication and Erection Personnel Qualifications:
   1. Trained and experienced in the type of work being performed.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Welders, Welding Operators and Tackers Qualifications:
   1. Qualified by tests in accordance with AWS D1.1.
   2. Qualification Papers:
      a. Given by an independent testing laboratory.
      b. Dated no earlier than 6 months prior to beginning of Project.
   3. Engineer, at Engineer's discretion, may accept evidence of previous qualifications.

C. Special Inspection of Steel Erection: In accordance with Division 01 Section “Special Inspections and Tests.”

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or distorted material and immediately remove from the Site. Replace rejected materials with new material at no additional cost to Owner.

D. Embedded Items:
   1. Includes anchor rods and other anchorage devices which are to be embedded in cast-in-place concrete or masonry.
   2. Delivered on the Project Site in time to be installed before the start of cast-in-place concrete or masonry operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Materials shall be new, top quality of their respective kinds, standard sizes and fabricated in a shop whose principal business is manufacturing the items specified in this Section.

B. Steel:
1. Wide Flange and WT Shapes: ASTM A992 with yield stress of 50,000 psi.
2. M, S, MT and ST Shapes, Channels, Angles, Bars, Plates and Rods: ASTM A36 with yield stress of 36,000 psi.
3. Rectangular and Square Tubular Shapes: ASTM A500, Grade C with yield stress of 50,000 psi.

C. Paint: In accordance with Division 09.

2.2 METAL FABRICATIONS

A. Trench Drain Frames: ASTM A36 steel.

B. Fasteners:
1. Bolts:
a. Use carbon or alloy steel, ASTM A325 3/4-inch diameter bolts or larger as required by connection design.
b. Use ASTM A490 3/4-inch diameter bolts or larger only if required by connection design.
c. If conditions require that galvanized materials be used, use ASTM A307 or A325 bolts. Do not galvanize A490 bolts, as that could possibly cause hydrogen embrittlement, and will affect hardness.
d. Stainless steel: ASTM F593, used where conditions of severe corrosion could occur.
2. Nuts:
a. Carbon Steel: ASTM A563.
b. Stainless Steel: ASTM F594.
3. Washers:
a. Hardened Steel Washers: ASTM F436.
b. Plain Washers: ASME B18.22.1, round, carbon steel.
c. Lock Washers: ASME B18.21.1, helical, spring type, carbon steel.
4. Lag Bolts: ASME B18.2.1, square or hex head type.
5. Toggle Bolts: Tumble wing type in accordance with FS FF-B-588.
6. Machine Screws: ASME B18.6.3.
7. Wood Screws: ASME B18.6.1.

C. Anchors: In accordance with Division 03 Section “Post-Installed Anchors”.

D. Other Materials: Other materials not specifically described but required for a complete and proper installation of the work of this Section, shall be new, first quality of their respective kinds, and as selected by Contractor subject to approval of Engineer.

2.3 FABRICATION

A. General:
1. Workmanship: Install items square and level, accurately fitted and free from distortion and defects.
2. Temporary Bracing:
a. Make provision for erection stresses by temporary bracing.
b. Keep work in alignment.
3. Welding:
a. Steel welding shall be performed in accordance with AISC Specification and AWS D1.1.
b. Filler metal requirements for steel welding processes shall be in accordance with AWS D1.1 and AWS A5.1.
c. Aluminum welding shall be performed in accordance with AWS D1.2.

d. Filler metal requirements for aluminum welding processes shall be in accordance with AWS A5.3.
e. Stainless steel welding shall be performed in accordance with AWS D1.6.
f. Filler metal requirements for stainless steel welding processes shall be in accordance with AWS A5.4.
g. Welding shall be continuous along entire area of contact.

4. Painting: Prime paint metal fabrications in accordance with Division 09.
5. Items fabricated from structural steel members which are to be architecturally exposed shall be given special attention for material selection with respect to rolling tolerances, surface finish and straightness.
6. Normal structural steel fabrication tolerances will not be acceptable where in conflict with the intent and requirements of this Section.
7. Curved beam sections shall be fabricated without distortion to top and bottom flange width and thickness.
8. Straightness tolerances, additive to deflection, shall not exceed ± 1/16-inch to 10 feet.
9. Cope, miter, and butt caps on exposed surfaces shall be made to the closest possible tolerances consistent with metal shop equipment and practice in order to provide a pleasing appearance.
10. Fastening shall be concealed where practicable. Thickness or metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water. Provide holes and connections for the work of other trades.

B. Galvanizing:
1. Hot-dipped galvanized after fabrication in accordance with ASTM A123.
2. 2.3 oz/ sq ft minimum.
3. Galvanize the following items:
a. Loose lintels.
b. Items so indicated on the Drawings.
c. Bollards.

C. Galvanized Fasteners:
1. Hot-dipped galvanized after fabrication in accordance with ASTM A153.
2. Class C (1.25 oz/sq ft) minimum coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Workmanship: Install items square and level, accurately fitted and free from distortion and defects.

B. Erection:
1. Bracing:
a. Provide all shoring, bracing and accessories required for complete erection.
b. Safety and adequacy of bracing and temporary bracing are the responsibility of the Contractor.

C. Coordination: Supply to appropriate trades items to be cast into concrete or embedded in masonry, complete with necessary setting templates.

D. Tightening:
1. Tighten bolts snug-tight as defined by AISC, unless otherwise noted on the Drawings.
2. Tighten bolts in slotted holes using the AISC Turn-of-the-Nut Method, unless indicated otherwise on the Drawings.
3. Where specifically indicated on the Drawings, finger-tighten nuts in connections where movement must be permitted, and tighten a jam nut over finger-tightened nut, or peen bolt threads, to prevent nut backoff.

E. Touch-up:
1. After erection is complete, touch up all shop priming coats damaged during transportation and erection.
2. Prime all field welds, bolt heads, nuts and abrasions using the priming paint specified for shop priming.
3. Touch up all damaged galvanized areas with a zinc rich paint meeting ASTM D520 and ASTM A780.

F. Welding: Field welding shall be performed to the same standards and requirements of shop welding.

G. Protection: Where required, provide approved protection against galvanic action between contacts of dissimilar metal or situations that will cause deterioration of metal in contact or associated in any way.

3.2 CLEANING

A. Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 05 50 00

SECTION 05 51 33 - METAL LADDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop-fabricated metal ladders.

1.2 RELATED REQUIREMENTS

A. Section 05 40 00 - Cold-Formed Metal Framing: Ladders affixed to metal stud framing

B. Section 06 10 00 - Rough Carpentry: Wood blocking.

C. Section 07 72 00 - Roof Accessories: Ladders serving roof hatches.

D. Section 09 21 16 - Gypsum Board Assemblies: Ladders affixed to gypsum board assemblies.

E. Section 09 91 23 - Interior Painting: Paint finish.

1.3 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; Current Edition.

B. 29 CFR 1926.1053 - Ladders; Current Edition.

C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

D. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

I. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

J. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

K. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

L. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.

M. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

O. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

Q. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

R. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

S. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

T. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

U. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

B. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

C. Designer's Qualification Statement.

D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.5 QUALITY ASSURANCE

A. Design ladder under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located. If ladder is being affixed to cold-formed metal framing, coordinate ladder loading and supports with cold-formed metal framing fabricator for framing gauge, spacing, etc.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

F. Bolts, Nuts, and Washers: ASTM A307.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED LADDERS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; galvanized finish.
   1. Side Rails: 1/2 inch by 3 inch, members spaced at 24 inches.
   2. Rungs: One inch diameter solid round bar spaced 12 inches on center.

2.4 FINISHES - STEEL

A. Prepare surfaces to be primed in accordance with SSPC-SP2.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Prime Painting: One coat.

D. Intermediate and Top Coat: Refer to Division 09, Interior Painting. ladder, including all brackets and anchors, color to be safety yellow.

2.5 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed .

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 055200 - HANDRAILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of handrails and railings is shown on drawings.

B. Types of Handrails and Railing Systems Required Include:

1. Aluminum pipe handrails, type HDRL-1.

1.3 SYSTEM PERFORMANCE REQUIREMENTS:

A. Structural Performance of Handrails and Railing Systems: Design, engineer, fabricate and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

1. Loads: ASCE 7, “Minimum Design Loads and Associated Criteria for Buildings and Other Structures,” Section 4.5.1.1, “Loads on Handrails and Guardrail Systems.”

2. Determine allowable design working stresses on railing materials based on material type.

3. Railings shall withstand the above loads with permanent set deflection not exceeding ½” when tested per ASTM E985-06.

4. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 200 lbs. applied at any point non-concurrently vertically downward or horizontally.
b. Uniform load of 50 lbs. per linear ft. applied non-concurrently, vertically downward or horizontally.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

5. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 200 lbs. applied at any point non-concurrently, vertically downward or horizontally.
b. Uniform load of 50 lbs. per linear ft. applied non-concurrently, vertically downward or horizontally.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

6. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 50 lbs. applied to one sq. ft. at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.

a. Above load need not be assumed to act concurrently with uniform horizontal loads on top rails of railing systems in determining stress on guard.

B. Thermal Performance Requirements:

1. Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

a. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS:

A. Product Data: Manufacturer's technical data for products and processes used in handrails and railing systems, including finishes and grout.

B. Shop Drawings: Show details of fabrication and installation for each type and material of handrail and railing system required including plans, elevations, sections, profiles of rails, fittings, connections and anchors.

1. Provide templates for anchor and bolt installation by others.
2. Include structural computations evidencing compliance of handrails and railing systems with design loadings indicated.

C. Samples: Prepare samples of each type of metal finish required on metal of same thickness and alloy indicated for final work. Where finish involves normal color and texture variations, include sample sets composed of two or more units showing limits of such variations expected in completed work.

1. Include 6" long samples of each distinctly different railing member including handrails, top rails, posts and balusters. Include samples of fittings and brackets if requested by Owner's Representative and Landscape Architect.

1.5 QUALITY ASSURANCE:

A. Single Source Responsibility: Obtain handrails and railing systems of each type and material from a single manufacturer.

B. Design Responsibility: Engage a qualified Professional Engineer to prepare or supervise the preparation of structural computations for handrails and railing systems to determine compliance with structural performance requirements indicated.

1. Engineer Qualifications: A Professional Engineer who is licensed to practice in jurisdiction where Project is located and who is experienced in providing structural engineering service of the kind required for work of this section.

1.6 STORAGE:

A. Store handrails and railing systems in a clean, dry location, away from uncured concrete and masonry, protected against damage of any kind. Cover with waterproof paper, tarpaulin or polyethylene sheeting; allow for air circulation inside the covering.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide handrails and railing systems of one of the following or other approved:

1. Aluminum handrail and guardrail System Manufacturers:

a. Elite Fence Products, Inc.
b. Ultra Fencing & Railing
c. American Fence & Supply Company
d. Aluminum Tube Railings, Inc.
e. Architectural Art Mfg., Inc.
f. Craneveyor Corp.
g. Julius Blum & Co., Inc.
h. Nexan Building Products
i. Tri-Tech Inc.
j. Wagner: R & B Wagner, Inc.
k. York Metal Fabricators, Inc.

2.2 METALS:

A. General: Comply with standards indicated for forms and types of metals indicated or required for handrail and railing systems components.

B. Aluminum: Provide alloy and temper recommended by aluminum producer or finisher for type of use and finish indicated, and with not less than the strength and durability properties of the alloy and temper designated below for each aluminum form required.

1. Extruded Bar and Shapes: ASTM B-221, 6063-T6
2. Plate and Sheet: ASTM B-209, 6061-T6
3. Castings: ASTM B-26, 356-T6

2.3 MISCELLANEOUS MATERIALS:

A. Nonshrink Nonmetallic Grout: Pre-mixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

B. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and as required for color match, strength and compatibility in fabricated items.

C. Fasteners: Use fasteners of same basic metal as the fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnection of handrail and railing components and for their attachment to other work, except where otherwise indicated.

D. Anchors and Inserts: Provide anchors of type, size and material required for type of loading and installation condition shown, as recommended by manufacturer, unless otherwise indicated. Use nonferrous metal of hot-dipped galvanized anchors and inserts for exterior locations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

E. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic)

F. Zinc Chromate Primer: FS TT-P-645

G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.4 FABRICATION:

A. General: Fabricate handrails and railing systems to design, dimensions and details shown. Provide handrail and railing members in sizes and profiles indicated, with supporting posts and brackets of size and spacing shown, but not less than required to comply with requirements indicated for structural performance.

B. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Welded Connections: Fabricate stainless steel handrails and railing systems for interconnections of members by welding. Use welding method which is appropriate for metal and finish indicated and develops strength required to comply with structural performance criteria. Finish exposed welds and surfaces smooth, flush and blended to match adjoining surfaces.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain profile of member throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of handrail and railing components.

E. Brackets, Flanges, Fittings and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings and anchors for interconnection of handrail and railing members to other work, unless otherwise indicated.

1. Furnish inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry work. Fabricate anchorage devices which can withstand loadings imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.

2.5 METAL FINISHES:

A. Comply with NAAMM "Metal Finishes Manual" for recommendations and designations of finishes, except as otherwise indicated.

B. Aluminum:

1. High Performance Organic Coating: AA-C12C42R1x (cleaned with inhibited chemicals, conversion coated with acid-chromate-fluoride-phosphate treatment and painted with organic coating specified below). Prepare, pretreat and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.

a. Fluorocarbon Coating: Manufacturer’s standard multicoat thermocured system, composed of specially formulated primer and fluorocarbon topcoats; complying with AAMA 605.2.
b. Color and Sheen: Textured (Matte) Black.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Installer must examine the areas and conditions under which handrails and railings are to be installed and notify the Owner’s Representative and Landscape Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 PREPARATION:

A. Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete as masonry construction. Coordinate delivery of such items to project site.

B. Field Measurements: Take field measurements prior to fabrication.

3.3 INSTALLATION, GENERAL:

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Perform cutting, drilling and fitting required for installation of handrails and railing systems. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Do not weld, cut or abrade surfaces of handrails and railing components which have been coated or finished after fabrication and are intended for field connection by mechanical means without further cutting or fitting.

C. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal-arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent rail surfaces.

D. Corrosion Protection: Coat concealed surfaces of aluminum which will be in contact with grout, concrete, masonry, wood or dissimilar metals, with a heavy coat of bituminous paint or zinc chromate primer.

E. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.

3.4 ANCHORING POSTS IN CONCRETE:

A. Direct Set: Form or core-drill holes not less than 6” deep and 3/4” larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer’ written instructions.

B. Exposed Joints:

1. Exterior Locations: Leave anchorage joint exposed with 1/8” buildup, sloped away from post.

3.5 RAILING CONNECTIONS:

A. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact or use manufacturer's standard fittings designed for this purpose.

3.6 ANCHORING RAILING ENDS:

A. Anchor railing ends into stonework as shown.

B. Expansion Joints: Provide expansion joints at locations indicated or, if not indicated, at intervals not to exceed 40 feet. Provide slip-joint interval sleeve extending 2" beyond joint on either side; fasten internal sleeve securely to one side, locate joint within 6" of post.

3.7 ATTACHMENT OF HANDRAILS TO WALLS:

A. General: Secure handrails to walls as shown.

B. Use drilled-in expansion shields and concealed hanger bolts, unless otherwise indicated.

3.8 ADJUSTING:

A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint and paint exposed areas with same material.

3.9 PROTECTION:

A. Protect finishes of railing system and handrails from damage during construction period by use of temporary protective coverings approved by railing manufacturer. Remove protective covering at time of Substantial Completion.

B. Restore finished damaged during installation and construction period so that no evidence remains of correction work. Return items which cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units as required.

END OF SECTION 055200

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior, floor mounted guardrails with swing gate, type HDRL-4.

1.2 RELATED REQUIREMENTS

A. Section 05 40 00 - Cold-Formed Metal Framing: Placement of railings on cold-formed metal floor joists.

B. Section 06 10 00 - Rough Carpentry: Floor sheathing and wood blocking for railings on cold-formed metal framed floors.

1.3 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.

C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.

E. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

1.4 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.

B. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.

C. Fabricator's Qualification Statement.

1.5 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

C. Fabricator Qualifications:
   1. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.1 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies to the more stringent requirements of those specified or those in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to floor assemblies, provide backing plates, for bolting anchors.
   2. Posts: Provide adjustable flanged brackets.

G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.2 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.
   1. Use Schedule 80 pipe where required to meet loading requirements.

C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

D. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

E. Straight Splice Connectors: Steel concealed spigots.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
1. Interior Components: Continuously seal joined pieces by continuous welds.
2. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Weld connections that cannot be shop welded due to size limitations.
1. Weld in accordance with AWS D1.1/D1.1M.
2. Match shop welding and bolting.
3. Clean welds, bolted connections, and abraded areas.
4. Touch up shop primer and factory-applied finishes.
5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

F. Fabricate transitions and changes in direction with smooth profiles free of bumps or other projections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be placed in floor assembly with setting templates, for installation as work of other sections.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

D. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.

E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural dimension lumber framing (Boardwalk).

B. Rough opening framing for doors, windows, and roof openings.

C. Exposed Attic Flooring.

D. Roofing nailers.

E. Preservative treated wood materials.

F. Fire retardant treated wood materials.

G. Miscellaneous framing and sheathing.

H. Communications and electrical room mounting boards.

I. Concealed wood blocking, nailers, and supports.

J. Miscellaneous wood nailers, furring, and grounds.

1.2 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).

C. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).

D. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.

G. AWPA U1 - Use Category System: User Specification for Treated Wood; 2023.

H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. PS 1 - Structural Plywood; 2019.

J. PS 20 - American Softwood Lumber Standard; 2021.

1.3 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes. Rough (unsurfaced).

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: Unfinished, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.3 EXPOSED DIMENSION LUMBER (BOARDWALK)

A. Sizes: Nominal sizes as indicated on drawings.

B. Surfacing: S4S.

C. Moisture Content: S-dry or MC19.

D. Framing for Joists, Boardwalk Beams, and Blocking
   1. Species: Southern Pine
   2. Grade: No. 1.

E. Circular deck 3-ply beams
   1. Species: Southern Pine
   2. Grade: Select structural.

F. Framing for Posts, Braces, and Fascia Supports
   1. Species: Southern Pine.
   2. Grade: No. 2

2.4 CONSTRUCTION PANELS

A. Exposed Attic Flooring and Interior Horizontal Applications: PS 1 or PS 2 type, rated Single Floor.
   1. Panel Type: Plywood.
   2. Bond Classification: Exposure 1.
   3. Performance Category: 19/32 PERF CAT.
   4. Edges: Tongue and groove for exposed attic flooring. Square at all other locations.

B. Wall Sheathing, Interior Vertical Applications: PS 1 type.
   1. Panel Type: Plywood.
   2. Grade: C-D.
   3. Bond Classification: Exposure 1.
   4. Edge Profile: Square.
   5. Thickness: As indicated on Drawings.

C. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Other Locations: PS 1, C-D Plugged or better.

2.5 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

B. Sill Gasket on Top of Concrete Piers: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
   1. Location: Provide sill gasket where wood joists are in contact with concrete piers at boardwalk.
   2. Color: Black

2.6 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Do not use treated wood in direct contact with the ground.

2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
   a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
   b. Exposed Attic Flooring.
   c. Interior rough carpentry items, concealed from view, including but not limited to wood blocking are to be fire retardant treated. Plywood panels utilized for mounting boards and substrate for architectural wall finishes are not required to be fire retardant treated.

C. Preservative Treatment:
1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A.
   a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
   b. Treat lumber in contact with roofing, flashing, or waterproofing.
   c. Treat lumber in contact with masonry or concrete.
   d. Treat lumber less than 18 inches above grade.
   e. All exterior lumber.
   f. All lumber located on exterior (outside) or air/vapor barrier.
   g. Treat lumber in other locations as indicated.
2. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A.
   a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.
   b. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA) in exposed exterior applications subject to leaching.

PART 3 EXECUTION

3.1 PREPARATION

A. Install sill gasket under sill plate where wood framing bears on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

B. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

D. Comply with fastener size and spacing indicated, but not less than required by applicable codes, AWC (WFCM) Wood Frame Construction Manual, and IBC Chapter 23 Wood Construction Spans and Fastener requirements.

3.3 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes, AWC (WFCM) Wood Frame Construction Manual, and IBC Chapter 23 Wood Construction Spans and Fastener requirements.

E. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.

F. Provide blocking at joists as indicated on Drawings and as spacing as required by deck manufacturer.

3.4 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. Provide the following specific nonstructural framing and blocking:
1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Art work.
8. Wall paneling and trim.
9. Joints of rigid wall coverings that occur between studs.
10. Wall or Ceiling mounted Owner Furnished Equipment.
11. Guardrails.

3.5 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.6 INSTALLATION OF CONSTRUCTION PANELS

A. Exposed Attic Flooring: Glue and screw to framing; nails or staples are not permitted.

B. Interior Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws; nails or staples are not permitted.

3.7 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.8 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.9 CLEANING

A. Waste Disposal:
1. Comply with applicable regulations.
2. Do not burn scrap on project site.
3. Do not burn scraps that have been pressure treated.
4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 15 33 – BOARDWALK DECKING AND RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the design, furnishing, and installation of boardwalk decking and railings, including:
   1. hdrl-2.
   2. hdrl-3.

1.3 SUBMITTALS

A. Submit complete shop drawings for entire decking assembly indicating all dimensions, spans, wood structure components and profile, composite decking, railing, drilled holes, fasteners, connectors, erection details, sequence and loads.

B. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

C. Submit certification that required pressure treatment complies with specification requirements.

D. Composite Decking: Provide (2) samples not less than 24” long showing the range of variation to be expected in appearance of decking, including surface texture.

E. Fasteners: Provide product data for decking fastening system components. Include installation instructions.

F. Guardrail:
   1. Product Data: Manufacturer’s specifications and technical data including the following:
      a. Detailed specifications of construction and fabrications
      b. Manufacturer's installation instructions
   2. Shop Drawings: Submit shop drawings for fabrication and installation. Include the following:
      a. Plans, elevations, and detail sections.
      b. Indicate materials, methods, finishes, and types of joinery, fasteners, anchorages, and accessory items.
      c. Where materials or fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis.

1.4 WARRANTY

A. Decking: Provide Timbertech Limited lifetime product warranty and a 50 year limited fade and stain warranty.

B. Guardrail: provide manufacturer’s standard 3 year warranty.

1.5 QUALITY ASSURANCE

A. Provide composite decking from one source.

B. Contractor to have not less than 10 years experience in deck and railing construction.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all wood and composite members with care during shipping and installation to maintain undamaged and unmarked exposed faces. Damaged members will be rejected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to drawings for specifications covering wood, steel and concrete components.

B. Composite Decking to be Timbertech Vintage Collection 3.5" and 5.5" widths as detailed on drawings, color to be selected. www.timbertech.com

C. Fasteners to be:
1. CONCEALoc hidden fasteners, color to be selected
2. Cortex top down screws with material matched plugs

D. Guardrail to be:
1. AGS Stainless Steel Railing System: Clearview Railing System as manufactured by AGS Stainless, Inc. which is located at: 7873 N. E. Day Rd.; Bainbridge Island, WA 98110; Toll Free Tel: 888-842-9492; Tel: 206-842-9492; Fax: 206-842-8179; Email: request info (info@agsstainless.com); Web: http://www.agsstainless.com
   a. Type: Rainier - Cable railing.
   b. Fabrication: Factory welded components. Verify dimensions on site prior to shop fabrication.
      1) Mill joints to a tight, hairline fit.
      2) Miter corner joints.
   c. Structural Requirements: Fabricate integral railings and component connections to meet or exceed the requirements as set forth in the current, adopted ICC International Building Code (IBC), or governing local code as applicable.
2. Posts:
   a. Post Material: ASTM A 554, Type A316 stainless steel, minimum Fy=40 ksi.
   b. Post Size: 1-1/2 inch (38.1 mm) x 1-1/2 inch (38.1 mm).
   c. Post Mounting Configuration: Top mount, as indicated on installation Drawings.
   d. hdrl-2 post to have premade openings/holes for downlights. Contractor to coordinate post order with electrical contractor in siteworks contract prior to placing order
3. Top Rails:
   a. Top Rail Material: ASTM A 554, Type A316 stainless steel, minimum Fy=40 ksi.
   b. Top Rail Shape, Size: Flat, 1/2 inch (12.7 mm) x 2 inch (50.8 mm) x 16 gauge tubing.
4. Infill – Cables (hdrl-2):
   a. Material: ASTM A 492, stainless steel, Type 316.
   b. Construction: 1 X 19.
   c. Diameter: 1/8 inch (3 mm) diameter.
   d. Lay: Left Hand Lang's.
   e. Core: Stainless steel.
   f. Cable Fitting Materials: Stainless steel, Type 316.
   g. Cable Attachments: Factory, machine swaged.
   h. Tensioning Method: Threaded terminals.
5. Finish: all material to be black finish
6. Hardware: Stainless steel construction; separate dissimilar materials with bushings, grommets or washers to prevent electrolytic corrosion.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerance and other conditions effecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substance detrimental to application.

3.3 DECKING INSTALLATION

A. Set work to required levels and lines, with members plumb, true to line, cut and fitted. Fit work to other constructions; scribe and cope and needed for accurate fit.

B. Install decking in accordance with manufacturer’s written instructions.

C. Secure decking to wood framing with concealed deck clips and screws.

D. Install lighting in curb rail as shown on plans

E. Provide blocking and framing as indicated on drawings and as required to support facing materials, fixtures, specialty items and trim.

F. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.

3.4 RAILING INSTALLATION

A. Install railing system plumb, level, and true and in accordance with manufacturer's installation instructions and recommendations.

B. Coordinate installation of electrical service and down lights with electrician under site work contract. Electrical service and lighting is in siteworks contract.

C. Do not tighten the cables more than what is necessary to eliminate any sag.

D. Provide anchorage devices and fittings to secure to in-place construction to adjacent construction. Separate dissimilar materials with bushings, grommets or washers to prevent electrolytic corrosion.

E. Do not cut components, except for cable as required for installation, or abrade component finishes. Field touch-up of finishes only acceptable if done as per manufacturer's recommendations. Return components with damaged finishes to shop for required alterations according to manufacturer's return policy, followed by complete refinishing or provide new components.

F. Secure mounting brackets to building structure in a positive manner using manufacturer recommended reinforcement and anchorage methods for substrate conditions. Locate brackets and hardware at spacing required to support structural loads.

G. Installation of railing system shall be rigid and secure, installed by mechanics experienced in erection of architectural metal. Mounting hardware shall be drawn up tightly. Rails shall be set plumb and aligned.

3.5 FINISH AND CLEAN UP

A. Following final installation of all synthetic wood decking, contractor shall remove all construction debris, dirt and dust from decking surface and joints.

END OF SECTION 06 15 33

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish carpentry items.

B. Wood casings and moldings.

C. Hardware and attachment accessories.

1.2 RELATED REQUIREMENTS

A. Section 09 91 23 – Interior Painting: Opaque finishing of wood elements.

B. Section 09 93 00 – Staining and Transparent Finishing: Staining and transparent finishing of wood elements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

A. Product Data:
   1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.

B. Samples: Submit three samples of each plastic laminate specified

C. Samples: submit three samples of each finished wood specified, submit veneer and solid wood samples together for match verification.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
   2. Single Source Responsibility: Provide and install this work from single fabricator.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.

B. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.

C. Protect from moisture damage.

D. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

C. Interior Woodwork Items:
   1. Profile: Dimensions and provide as indicated on Drawings.
   2. Moldings, Bases, Casings, and Miscellaneous
      a. Wood Base Type WB1: Poplar; primed, prepare for paint finish.
      b. Wood Base Type WB2: White maple conditioned and stained to match WWP1 walnut wood.
      c. Wood Base Type WB3: White Oak, stained to match WD2 reconstituted rift white oak veneer.
      d. Wood Trim, Painted: Poplar; primed, prepare for paint finish.
      e. Wood Trim, WD2: Moldings and trims labeled WD2 to be solid White Oak to match WD2 veneer.
      f. Wood Door Frames: Wood species to match species and finish of adjacent wood trim.
      g. Wood Trim: Where wood trim is identified, but a finish is not provided, wood species and finish to match species and finish of adjacent wood veneer.

2.2 LUMBER MATERIALS

A. Hardwood Lumber: species & sawn as indicated on drawing, maximum moisture content of 6 percent ; with vertical grain , of quality suitable for transparent finish.

2.3 SHEET MATERIALS

A. Hardwood Plywood: Face species as indicated, plain sawn, running matched, particleboard core; HPVA HP-1 Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

B. Particleboard: ANSI A208.1 Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

2.4 PLASTIC LAMINATE MATERIALS

A. Plastic Laminate: NEMA LD 3; as indicated on drawings.

B. Low Pressure Laminate: Melamine; White color, Solid pattern and surface texture as selected.

C. Laminate Backing Sheet: NEMA LD 3, BKL; undecorated plastic laminate.

D. Laminate Adhesive: Type recommended by laminate manufacturer to suit application; not containing formaldehyde or other volatile organic compounds.

2.5 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. General: Furnish fastening materials of types appropriate for the conditions encountered, including wood to wood, wood to masonry or concrete and wood to metal. Use nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

C. Nails and Staples: Galvanized carbon steel, conforming to the requirements of ASTM F1667. Wood Screws: Galvanized carbon steel per ASME B 18.6.1.Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers. Expansion Anchors: Anchor bolt and sleeve assembly of carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5 with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agency. Adhesives: Aliphatic resin polyurethane, or resorcinol wood glue recommended for general carpentry use.

2.6 SHELVING AND CLOTHES RODS

A. Shelving and Clothes Rods
   1. Shelving: 3/4-inch particleboard or medium density fiberboard shelving with solid-wood front edge.
      a. Shelf Cleats: 3/4-by-3 1/2-inch boards with holes to receive clothes rods, of same species and grade indicated above for interior lumber trim for opaque finish.
      b. Shelf Brackets: Prime-painted formed steel with provision to support clothes rod where rod is indicated.
      c. Clothes Rods: 1-1/2-inch- (38-mm-) diameter aluminum tubes, or prefinished steel tubes.

2.7 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Primer: Alkyd primer sealer.

C. Wood Filler: Solvent base, tinted to match surface finish color.

D. Drive Screws Anchors: Non-staining, self-tapping and drilling, size and type to suit application.

2.8 WOOD TREATMENT

A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.

B. Redry wood after pressure treatment to maximum 15% percent moisture content.

2.9 SITE FINISHING MATERIALS

A. Stain and Finishing Materials: In compliance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.10 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. Cap exposed plastic laminate finish edges with plastic trim.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

E. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

2.11 SHOP FINISHING

A. Apply wood filler in exposed nail and screw indentations.

B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5- Finishing for grade specified

C. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure materials and components in place, plumb and level.

C. General Millwork
   1. Provide all wood blocking and framing required to support items of finish carpentry. Use fastening materials of types appropriate for the conditions encountered, including wood to wood, wood to masonry, and wood to metal stud framing. Counterbore holes for nuts and bolt heads, and countersink for screws. Use concealed fasteners in exposed surfaces of finish carpentry.
   2. Before installing finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.
   3. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements. Do not use manufactured units with defective surfaces, sizes, or patterns.
   4. Furnish millwork in configurations shown and specified. AWI grading will take precedence over joiner details shown on Drawings. Provide tight joints. Miter exterior angles, cope interior angles and

returns of trim moldings. Provide blind nailing where practicable. Secure work with finishing nails or screws and glue. Install trim in maximum practical lengths.

5. On surfaces exposed to view, set all nail heads and spackle. Countersink all screw heads and cover with neatly fitted wood plugs to match grain. Sand in accordance with AWI grading. Fit and scribe all work to walls or other finished work in a careful manner, so as not to injure the surface in any way.

D. Paneling Installation

1. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Leaving 1/4-inch gap to be covered with trim at top, bottom, and openings. Install with uniform tight joints between panels.
   a. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners as recommended by panel manufacturer.
   b. Conceal fasteners to greatest practical extent.
   c. Arrange panels with grooves and joints over supports. Fasten to supports with nails of type and at spacing recommended by panel manufacturer. Use fasteners with prefinished heads matching groove color.

E. Clean up

1. Clean up and dispose of all waste material and refuse that has been brought onto the job or that has accumulated as a result of the work. Leave the work broom clean or better.
2. Replace finish carpentry that is damaged or does not comply with requirements. Finish carpentry may be repaired or refinished if work complies with requirements and show no evidence of repair or refinishing. Adjust joinery for uniform appearance.
3. Touch up any damaged finishes to restore to new matching adjacent areas.

END OF SECTION

SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Hardware.

1.2 SUBMITTALS

A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

B. Product Data: Provide data for hardware accessories.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
   2. Single Source Responsibility: Provide and install this work from single fabricator.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

B. Store tambour material in original packaging in area of installation for minimum period of 48 hours prior to installation.

C. Avoid storing tambour near direct heat source, open window or ventilation openings.

1.5 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:
   1. Finish - Exposed Exterior Surfaces: Decorative laminate.
   2. Finish - Exposed Interior Surfaces: Decorative laminate.
   3. Finish - Semi-Exposed Surfaces: Decorative laminate
   4. Finish - Concealed Surfaces: Manufacturer's option.
   5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
   6. Door and Drawer Front Retention Profiles: Fixed panel.
   7. Patterned Face Layout for Cabinet and Door Fronts: Flush panel.
      a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
   8. Cabinet Style: Flush overlay.
   9. Cabinet Doors and Drawer Fronts: Flush style.
   10. Drawer Side Construction: Manufacturer's option.

2.2 CUSTOM RECEPTION DESK

A. Top and Face finish: Thermoformed solid surface with seamless inconspicurous jointing.
   1. Manufacturuer, color, pattern and size: As inidcated on drawings
   2. Polish all exposed edges

B. Base face finish: Flexible wood tambour sheet, adhered to substrate
   1. Manufacturuer, color, pattern and size: As inidcated on drawings
   2. Butt adjacent panels for inconspicurous seems
   3. Adhesive: B3 water based
   4. Install with press and silicone rubber pad to avoid crushing
   5. Seal with clear water based transparent matt finish sealant

C. Curved Panel Construction: Bending-Grade Plywood

D. Interior finish: Laminate
   1. Manufacturer, color, pattern and size: As indicated on drawings

E. Hardware: Brush Strip
   1. Manufacturer: Mockett
   2. Product: BR Brush strip
   3. Size: 1 3/4" wide, 3/16" thick, cut-to-fit legth - refer to drawings for length
   4. Color: Grey
   5. nstallation: mechanically fastened

2.3 PANEL CORE MATERIALS

A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.
   1. Grade: M-2; moisture resistance: MR10.
   2. Panel Thickness: 1/2 inch.

2.4 THERMALLY FUSED LAMINATE PANELS

A. Thermally Fused Laminate (TFL): Melamine-resin-saturated decorative papers; for fusion to composite wood substrates under heat and pressure.
   1. Test in accordance with NEMA LD 3 Section 3.
   2. Panel Core Substrate: Medium Density Fiberboard (MDF).
   3. Color: White.

2.5 LAMINATE MATERIALS

A. Provide specific types as follows:
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, colors as indicated, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, colors as indicated, finish as indicated.
   3. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.6 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: Match cabinet face laminate.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

D. Grommets: Standard As indicated on drawings grommets for cut-outs, in color as selected by Architect from Manufacter's full range.

2.7 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

C. Drawer and Door Pulls:
   1. Manufacturer: Mockett
   2. Product: DP268C - 7-5/32” Knurled Drawer Pull
   3. Finish: Satin Brass

D. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, bronze with satin finish.

E. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Commercial grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide self closing/stay closed type.

F. Hinges: European style concealed self-closing type, steel with satin finish.

G. ADA pre-fabricated toe-kick bracket, Basis of Design:
   1. Manufacturer: Wurth Wood Group
   2. Product: Ez-Kick Metal ADA Toe Kick
   3. Size: 12 inch x 3 inch
   4. Color: White

2.8 GLASS DISPLAY SHELVES

A. Glass:
1. Thickness: 3/8" thick, minimum.
2. Color: clear, low iron.
3. Type: tempered.
4. Edge: flat polished edge.

B. Supports:
1. Manufacturer: Mockett
2. Product: SH48B Large Elegant Shelf Bracket,
3. Finish: Satin Nickel (17S) finish
4. Size: 1 3/16" wide, 9 1/32" projection
5. Weight capacity: 25 lbs per bracket
6. Maximum shelf depth of 12" supported
7. 24" maximum distance between brackets

2.9 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
2. Cap exposed plastic laminate finish edges with plastic trim.

E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Seal cut edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 PREPARATION

A. Allow flexible tambour material to acclimate to the area it will be installed for at least 48 hours prior to finishing and installing.

B. Apply finish to tambour material within 24 hours of unpackaging.

3.3 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.4 ADJUSTING

A. Adjust moving or operating parts to function smoothly and correctly.

3.5 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 06 64 00 - PLASTIC PANELING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fully adhered, translucent architectural resin panels (PETG) mounted to interior wall substrates.

B. Adhesives, sealants, joint treatments, and accessories required for a complete, fully adhered installation.

1.2 SUBMITTALS

A. Product Data: For each panel and trim type.

B. Shop Drawings:
   1. For each wall paneling layout, indicate:
      a. Elevations: Dimensioned locations of panels and penetrations. Include field measurements indicating extents of paneling.

C. Samples: For each wall panel type, two samples, 6 inches by 6 inches in size, indicating specified color, texture, finish, and interlayer.

D. Installer's qualification statement.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm specializing in manufacturing architectural resin panels with a minimum of 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.

B. Store products in clean, dry, interior areas in accordance with manufacturer's instructions.

C. Store panels horizontally on flat, level surfaces in a climate-controlled interior space. Do not store panels vertically or lean them against walls.

D. Maintain temperature between 50 deg F and 85 deg F, and relative humidity below 65 percent in storage and installation zones for 48 hours prior to, during, and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Plastic Paneling:
   1. Basis-of-Design Product: 3form, Inc; www.3-form.com.

2. Substitutions: Substitutions are not permitted unless explicitly approved in writing by the Architect prior to bidding.

2.2 MATERIALS

A. General Panel Properties: Co-polyester resin panels (PETG), flat, sheet-extruded, with structural fire-performance performance meeting a Class A rating when tested in accordance with ASTM E84.
   1. Resin Panel Type PWP1a:
      a. Product Series: 3form Varia.
      b. Backing layer: E01 Reflect, opaque, highly reflective engineered foil backing
      c. Thickness: 1/4" (6mm) Nominal
      d. Finish: Vellum
      e. Color: As indicated on drawings
   2. Resin Panel Type PWP1b:
      a. Product Series: 3form Varia.
      b. Backing layer: E01 Reflect, opaque, highly reflective engineered foil backing
      c. Thickness: 1/2" (12mm) Nominal
      d. Finish: Vellum
      e. Color: As indicated on drawings

2.3 ACCESSORIES

A. Panel Wall Adhesive type recommeded by paneling manufacurer for applicaiton: High-performance, neutral-cure, non-staining 100 percent silicone or water-based mastic explicitly recommended and certified by 3form for full-surface adherence to primed drywall.
   1. Strictly Prohibited: Solvent-based construction adhesives, polyurethane adhesives, and acidic (acetoxy-cure) silicones that cause chemical crazing, degradation, or yellowing of PETG panels.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field measurements are as indicated on shop drawings.

B. Examine wall substrates for compliance with installation tolerances. Drywall surfaces must be clean, dry, free of grease, dust, or contaminants, and finished to a minimum Level 4 standard.

C. Wall Flatness Tolerance: Verify that the wall substrate varies by no more than 1/8 inch in any 10-foot radius. High spots must be sanded down and low spots filled; irregularities will telegraph through the adhered panels.

D. Moisture Testing: Do not begin installation until the building is fully enclosed and drywall joint compound is completely dry and cured.

E. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

F. Verify mechanical, electrical, and other building components affecting work of this section are placed and ready to receive work of this section.

3.2 PREPARATION

A. Surface Preparation: Clean substrate surfaces prior to installing paneling.

B. Acclimatization: Condition resin panels and adhesives to room temperature and humidity requirements specified in Section 1.5 for at least 48 hours prior to installation.

C. Substrate Priming: Drywall surfaces must be sealed with a high-quality, 100% acrylic primer-sealer approved by the adhesive manufacturer. Allow primer to fully dry for 24 hours before applying adhesive.

D. Remove protective film masking from panel faces within 48 hours of final installation.

3.3 INSTALLATION

A. Install panels and trim in accordance with manufacturer's written instructions and approved shop drawings.

B. A. Cutting and Fabricating: Cut and drill resin panels using clean, sharp tools specifically rated for plastics, following 3form's technical fabrication guidelines. Smooth all field-cut edges.

C. Adhesive Application:
   1. Do not remove protective masking from the face of the panels until installation is completed.
   2. Apply manufacturer-approved adhesive to the back of the panel or directly to the primed wall in strict accordance with the manufacturer's recommended bead pattern
   3. Do not apply adhesive in closed loops or horizontal solid frames that trap air pockets.

D. Panel Placement:
   1. Press panels firmly against the substrate using a clean roller to distribute pressure evenly and eliminate air gaps. Secure with temporary bracing or mechanical supports as needed until adhesive fully cures.

E. Joints: include 1/8" Quirk at panel butt joints

F. all mitered joints to include polished edges

3.4 CLEANING AND PROTECTION

A. Clean resin panels in strict accordance with 3form recommendations using warm water, a mild non-abrasive liquid detergent, and a clean microfiber cloth.
   1. Strictly Prohibited: Abrasive pads, squeegees, glass cleaners, or harsh chemical solvents (acetone, alcohol, benzene) that scratch or degrade the resin surface.

B. C. Protect completed resin installations from subsequent construction damage. Replace any panels that become scratched, cracked, or marred prior to Substantial Completion.

END OF SECTION

SECTION 06 83 16 - FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

B. Trim.

1.2 REFERENCE STANDARDS

A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. FDA Food Code - Chapter 6 - Physical Facilities; Current Edition.

1.3 SUBMITTALS

A. Product Data: Furnish to the Contractor only if submitting alternates. Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
1. Basis of Design: Marlite, Inc.
2. Crane Composites, Inc.
3. Nudo Products, Inc.
4. Panolam Industries International, Inc.

2.2 PANEL SYSTEMS

A. Wall Panels:
1. Panel Size: As indicated on Drawings.
2. Panel Thickness: 0.090 inch, minimum.
3. Panel Color: As indicated on Drawings.
4. Surface Design: As indicated on Drawings.
5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.3 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
   2. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.
   3. Chemical Cleanability: Excellent chemical resistance to common cleaners and detergents when tested in accordance with ISO 2812-1.

B. Trim: Vinyl; color coordinating with panel.

C. Adhesive: Type recommended by panel manufacturer.

D. Sealant: Type recommended by panel manufacturer; color matching panel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

3.2 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut panels with carbide tipped saw blades, drill bits, or snips.

C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturer's recommended gap for panel field and corner joints.

F. Place trim on panel before fastening edges, as required.

G. Fill channels in trim with sealant before attaching to panel.

H. Install trim with adhesive and screws or nails, as required.

I. Seal gaps at floor and between panels with applicable sealant to prevent moisture intrusion.

J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation.

B. Mineral fiberboard insulation.

C. Foamed in place air barrier sealant for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2 RELATED REQUIREMENTS

A. 04 20 00 – Unit Masonry: Insulation in Exterior Wall Assemblies.

B. 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings.

C. Section 07 27 00 - Air / Vapor Barriers: Air / vapor barrier materials.

D. Section 09 21 16 - Gypsum Board Assemblies: Insulation in Interior Metal Framed Partitions.

1.3 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2018.

G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.4 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.5 MOCK-UPS

A. Construct thermal insulation as part of Mock-Up construction indicated in Division 04, Unit Masonry.

1.6 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

B. Insulation Over Exterior Metal Stud Framed Walls, Continuous: Extruded polystyrene (XPS) board.

C. Mineral Wool Board Thermal Insulation with no vapor retarder, locations as indicated on Drawings.

D. Acoustic Insulation in Interior Metal Framed Partitions: Refer to Division 09, Gypsum Board Assemblies.

2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with natural skin surfaces.
   1. Location: Below grade, perimeter foundation.
   2. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   3. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   4. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   5. Complies with fire resistance requirements specified as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   6. Thermal Resistance:
      a. Below grade installation: Minimum R15 for total thickness at 75 degrees F mean temperature.
   7. Board Edges: Tongue-and-Groove.
   8. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
   9. Products:
      a. Dow Chemical Company.
      b. Kingspan Insulation LLC.
      c. Owens Corning Corporation.

B. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Comply with ASTM C578, and manufactured using carbon black technology.
   1. Location: Above grade, cavity insulation.
   2. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   3. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   4. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   5. Complies with fire resistance requirements specified as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   6. Type and Thermal Resistance, R-value: Type IV, 5.6 (0.98), minimum, per 1 inch thickness at 75 degrees F mean temperature.
   7. Board Thickness: 3 inch.
   8. Board Edges: Square.
   9. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
   10. Products:
      a. Dow Chemical Company.
      b. Kingspan Insulation LLC.

c. Owens Corning Corporation.

2.3 MINERAL FIBER BOARD INSULATION MATERIALS

A. Mineral Wool Board Thermal Insulation: Complying with ASTM C612 or ASTM C553.
1. Facing: None, unfaced.
2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
3. Board Thickness: As indicated on the drawings.
4. Thermal Resistance: R-value of 4.3 degrees F hr sq ft/Btu per inch at 75 degrees F, minimum, when tested according to ASTM C518.
5. Maximum Density: 8 pcf, nominal.
6. Products:
a. Johns Manville.
b. ROCKWOOL (ROXUL, Inc).
c. Specialty Products & Insulation (SPI).
d. Thermafiber, Inc.

2.4 ACCESSORIES

A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
1. Application: Sealing of interior circular penetrations, such as pipes or cables.
2. Width: As required for application.

B. Foamed in place air barrier sealant.
1. Low Pressure Type: Closed-cell, semi-flexible soft, single-component polyurethane sealant. GREAT STUFF PRO™ Window & Door Insulating Foam Sealant by DuPont, or equivalent product by another manufacturer, approved by the Architect.

C. Flashing Tape: Special reinforced film with high performance adhesive.
1. Application: Window and door opening flashing tape.
2. Width: As required for application.
3. Products:
a. 3M; All Weather Flashing Tape 8067.
1) Tapes containing rubberized asphalt, butyl, or other components that are not compatible with silicone are not permitted.
2) Provide premanufactured corners. Site fabricated corners will not be permitted.

D. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

E. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

F. Protection Board for Below Grade Insulation: Closed cell, extruded polystyrene (XPS), 1/4 inch thick.

G. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Verify that air / vapor barriers have been installed correctly for insulation which is to conceal vapor barriers.

C. Verify that flashings have been installed correctly for insulation which is to be installed in conjunction with through wall flashings.

D. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

E. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

F. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

G. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

H. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Adhere a 6 inches wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints.

B. Apply adhesive to back of boards, applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

C. Install boards horizontally on foundation perimeter.
   1. Install in running bond pattern.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

E. Immediately following application of board insulation, place protective boards over exposed insulation surfaces.

3.5 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere 6 inches wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.

B. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inches wide sealant tape; comply with ASTM E2357.

C. Install boards horizontally on walls.
   1. Install in running bond pattern.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

E. Place 6 inches wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.

F. Tape insulation board joints.

G. Apply low-rise foam insulation at penetrations, anchors and at joints in boards and all gaps or openings in insulation thermal plane.

3.6 MINERAL WOOL BLOCK, BOARD, OR BLANKET INSTALLATION

A. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.
   4. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.7 APPLICATION OF FOAMED IN PLACE AIR BARRIER SEALANT

A. Apply foamed-in-place air barrier sealants in strict accordance with manufacturer’s installation guidelines. Avoid overfilling restricted spaces. Apply low pressure foamed-in-place sealant in gaps and cracks adjacent to door and window frames and other gaps in construction. Clean overspray from adjacent surfaces and ensure a suitable substrate for subsequent work.
   1. Apply low-rise foam insulation at penetrations, anchors and at joints in boards and all gaps or openings in insulation thermal plane.

3.8 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 27 00 - AIR / VAPOR BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air barriers.

B. Air / Vapor barriers.

1.2 RELATED REQUIREMENTS

A. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with air barriers.

1.3 DEFINITIONS

A. Air Barrier: Airtight barrier made of material that is virtually air impermeable but water vapor permeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

B. Air / Vapor Barrier: Airtight barrier made of material that is virtually air impermeable and water vapor impermeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

1.4 REFERENCE STANDARDS

A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

D. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

1.5 SUBMITTALS

A. Product Data: Provide data on material characteristics, performance criteria, and limitations.

B. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.6 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Evaluated Air Barrier Assemblies. Use evaluated materials from a single manufacturer regularly engaged in air / vapor barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.7 MOCK-UPS

A. Air / Vapor barrier to be installed as part of Unit Masonry mock-up, refer to Section 04 20 00.

B. Mock-up may remain as part of work.

1.8 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.1 AIR BARRIER (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)

A. Air Barrier Sheet, Self-Adhered:
1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
3. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 90 days of weather exposure.
4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
5. Seam and Perimeter Tape: As recommended by sheet manufacturer.
6. Products:
   a. Basis of Design: Henry Corporation; Blueskin VP160.
   b. Carlisle.
   c. GCP Applied Technologies.
   d. Tremco Commercial Sealants and Waterproofing.

2.2 AIR / VAPOR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR IMPERMEABLE)

A. Air / Vapor Barrier Sheet, Self-Adhered:
1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 0.1 perms, maximum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method.
3. Water Penetration Resistance Around Nails: Pass, when tested in accordance with ASTM D1970/D1970M (modified).
4. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
5. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
6. Seam and Perimeter Tape: As recommended by sheet manufacturer.
7. Products:
   a. Basis of Design: Henry Corporation; Blueskin SA.
   b. Carlisle.
   c. GCP Applied Technologies.
   d. Tremco Commercial Sealants & Waterproofing

2.3 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.
   1. Products containing rubberized asphalt, butyl, or other components that are not compatible with silicone are not permitted.

B. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrate and air / vapor barrier materials.
   1. Application: Apply at 30 to 40 mil, 0.030 to 0.040 inch, nominal thickness.
   2. Color: Green or Red.

C. Primer: Product compatible with and recommended by the vapor barrier manufacturers installation instruction.

D. Flashing: Refer to Section 076200 - Sheet Metal Flashing and Trim.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready for work of this section.

B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

C. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Seal any gaps or openings within substrate per air / vapor barrier manufacturer, which are larger than air / vapor barrier manufacturer written requirements.

C. If required by manufacturer, prime substrate to receive air / vapor barrier prior to air / vapor barrier installation.

D. Air / Vapor Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

E. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

F. Self-Adhered Sheets:
   1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
   2. Lap sheets shingle fashion to shed water and seal laps airtight.
   3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
   4. Use same material, or other material approved by sheet manufacturer, to seal to adjacent substrates, other air / vapor barriers and as flashing.
   5. At wide joints, provide extra flexible membrane allowing joint movement.

G. Openings and Penetrations in Exterior Air / Vapor Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
   3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
   4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
   5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

3.4 FIELD QUALITY CONTROL

A. Do not cover installed air / vapor barriers until field observation has been completed by air / vapor manufacturer and Architect.

B. Obtain approval of installation procedures from air / vapor barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.

C. Take digital photographs of each portion of installation prior to covering up air barriers.

3.5 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Membrane roofing.

B. Cover board.

C. Insulation.

D. Vapor retarder.

E. Substrate board.

F. Walkways and safety strips.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry.

B. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.3 REFERENCE STANDARDS

A. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023.

D. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2023).

E. ASTM D312/D312M - Standard Specification for Asphalt Used in Roofing; 2016a (Reapproved 2023).

F. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).

G. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2015a (Reapproved 2021).

H. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016 (Reapproved 2023).

I. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing; 2021.

J. ASTM D6163/D6163M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements; 2021.

K. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011 (Reapproved 2019).

L. FM (AG) - FM Approval Guide; Current Edition.

M. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2022).

N. NRCA (RM) - The NRCA Roofing Manual; 2023.

O. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Review preparation procedures, installation procedures, and coordination and scheduling of related work.

B. Scheduling: Schedule applications to ensure partially completed sections of roof are not left exposed at end of workday.

1.5 SUBMITTALS

A. Product Data: Indicate membrane materials, flashing materials, insulation, vapor retarder, cover board, and fasteners.

B. Shop Drawings: Indicate interfaces with other materials, tapered insulation setting plan, and termination details.

C. Manufacturer's qualification statement.

D. Installer's qualification statement.

E. Specimen warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with minimum 20 of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified, with minimum 5 of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original packaging, dry and undamaged, with seals and labels intact.

B. Store materials above ground in area protected from weather.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.8 FIELD CONDITIONS

A. Do not apply roofing membrane when ambient temperature range is outside manufacturer's recommendations.

B. Do not apply roofing membrane to damp or frozen deck surface. Do not apply membrane when precipitation is expected or occurring.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than capable of weatherproofing in same day.

D. Proceed with work so new roofing materials are not subject to construction traffic as work progresses.

E. Do not allow grease, oils, fats, or other contaminants to come into direct contact with roofing membrane.

1.9 WARRANTY

A. Manufacturer Warranty:
1. Single-source special guarantee includes roofing membrane, accessories, basic flashing, and other single-source components of roofing system approved by manufacturer, including roof insulation, fasteners, adhesives, vapor retarder, and manufacturer's edge metal products. Guarantee to agree to repair or replace roofing system that leaks or is damaged due to wind or other natural causes.
2. Guarantee Period: 30 years from date of substantial completion.
3. Guarantee for repair and replacement to include costs of both material and labor in warranty.
4. Exceptions not permitted, are as follows: Damage due to wind speeds greater than 55 mph and less than 90 mph.

B. Installer Warranty: Provide 2-year warranty for roofing commencing on date of substantial completion. Complete forms in Owner's name and register with installer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Johns Manville; JM PVC SD Plus.

B. Carlisle SynTec Systems.

C. GAF.

D. Elevate Commercial Building Products.

E. Source Limitations: Obtain components for roofing system from a single roof membrane manufacturer or manufacturers approved by the single roof membrane manufacturer.

2.2 MEMBRANE ROOFING

A. Roof Assembly Performance Requirements:

1. Design of system to be based on:
   a. Warranty requirements.
   b. Building structural loading criteria.
   c. Building structural design pressures.
2. Solar Reflectance: Minimum 95 initial reflectance and minimum 80 reflectance after 3 years; calculated in accordance with ASTM E1980.
   a. Do not use field-applied coating to achieve specified SRI.

B. Membrane: Polyvinyl chloride (PVC)with Polyester Reinforcing; comply with ASTM D4434/D4434M, Type III, with fiber-reinforced edges.
1. Thickness: 80 mils, 0.08 inch, minimum.
2. Width: Factory fabricated into widest possible sheets.
3. Installation: Adhered with adhesive.
4. Color: White.

C. Seaming Materials: As recommended by membrane manufacturer.

2.3 COVER BOARDS

A. Cover Board: High compressive strength polyisocyanurate (ISO) insulation bonded to fiberglass-reinforced facer; comply with ASTM C1289, Type II, Class 1, Grade 1.
1. Compressive Strength: 80 psi when tested in accordance with ASTM D1621.
2. Thickness: 1/2 inch.
3. Basis of Design Product: Johns Manville; Protector HD.

2.4 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
1. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of core foam.
   a. Class 1 - Faced with glass-fiber-reinforced cellulosic facers on both major surfaces of core foam.
   b. Compressive Strength: Grade 3, 25 psi, minimum.
   c. Thermal Resistance R-value: R-30 minimum for roof insulation. R-value computation to include thermal insulation only. Average R-value of tapered insulation is not allowed to be included in R-value computation.
2. Size: 4 by 8 feet.
3. Thickness: As required to meet minimum roof R-value resistance, 2 layers minimum
4. Tapered Board: Slope as indicated on drawings, with 1/4-inch minimum thickness.
5. Basis of Design Product: Johns Manville; ENRGY 3.

2.5 VAPOR RETARDER

A. Vapor Retarder: Fiber glass-reinforced, polyethylene surfaced, self-adhering sheet.
1. Basis of Design Product: Johns Manville: JM Vapor Barrier SAR.
2. Primer: As required by manufacturer.

2.6 SUBSTRATE BOARD

A. Deck Substrate Boards: Glass-mat-faced gypsum panels; comply with ASTM C1177/C1177M, fire resistant type, 1/2 inch thick.
1. Basis of Design Product: Georgia-Pacific DensDeck Prime.

2.7 WALKWAYS AND SAFETY STRIPS

A. Flexible Walkways: Factory-formed, nonporous, slip-resistant PVC walkway pads with surface texture.
   1. Basis of Design Product: Johns Manville; JM PVC Heavy Duty Walkpad.

2.8 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

B. Cant Strips and Nailers: As indicated in Division 6 - Rough Carpentry.

C. Flashing:
   1. Metal Flashing: As indicated in Division 7 Section Sheet Metal Flashing and Trim.
   2. Sheet Flashing: Same material, thickness and color as PVC membrane.
   3. Termination Bar: Predrilled stainless steel bars, attached with anchors.

D. Pre-Finished, Edge Metal / Coping: Comply with ANSI/SPRI/FM 4435/ES-1.
   1. Metal Flashing: As indicated in Division 07, Sheet Metal Flashing and Trim.

E. Fasteners: Appropriate for application indicated as recommended and approved by single roof membrane manufacturer or manufacturers approved by the single roof membrane manufacturer.

F. Adhesives: As recommended by membrane manufacturer.

G. Primer: Manufacturer's recommended product.

H. Roofing Asphalt: ASTM D312/D312M, Type IV, as recommended by membrane manufacturer.

I. Asphalt Primer: Comply with ASTM D41/D41M, as recommended by membrane manufacturer.

J. Primer for Self-Adhered Vapor Retarders: One-part penetrating primer, as recommended by membrane manufacturer.

K. Sealants: As recommended by membrane manufacturer.

L. Insulation Joint Tape: As recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

M. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify readiness of surfaces, substrates, and site conditions to receive work in accordance with manufacturer's instructions.

B. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, sloped as indicated on drawings, and suitable for installation of roof system in accordance with approved shop drawings.

C. Verify installation of roof openings, curbs, and penetrations is in accordance with approved shop drawings.

D. Ensure secure deck attachment and support.

E. Verify placement of cant strips.

3.2 PREPARATION

A. Deck, General:
   1. Prime deck surface in accordance with manufacturer's instructions.

B. Metal Deck:
   1. Deck Substrate Board:
      a. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
      b. Cut substrate board cleanly and accurately at roof breaks and protrusions to provide smooth surface.
      c. Tape joints.
      d. Mechanically fasten substrate board to roof deck in accordance with roofing manufacturer's instructions and FM DS 1-28.
         1) Fasten per manufacturer’s requirements and to meet the design criteria.

3.3 INSTALLATION

A. Perform work in accordance with NRCA (RM) and NRCA (WM).

B. Membrane:
   1. Roll out membrane, free from wrinkles or tears. Place sheet without stretching.
   2. Attachment: Fully adhere membrane in accordance with manufacturer's instructions.
   3. Seams: Overlap edges and ends and seal seams by heat welding, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
   4. At edge metal / coping, extend membrane under metal and to outside face of wall. Membrane flash over top of horizontal face of edge metal / coping.
   5. Intersections with Vertical Surfaces:
      a. Extend membrane over cant strips and up minimum of 4 inches onto vertical surfaces. Terminate membrane as indicated on Drawings.

C. Cover Boards:
   1. Attachment: Embed cover board in adhesive in accordance with roofing and cover board manufacturers' instructions.
   2. At roof drains, use field-trimmed boards to slope down to roof drains over distance of 18 inches.
   3. Install cover board with joints in continuous straight line. Stagger joints between rows in accordance with manufacturer's instructions. Fill gaps exceeding 1/4 inch with cover board.

D. Insulation:
   1. Attachment:
      a. Mechanically fasten insulation in accordance with manufacturer's instructions and FM (AG).
      b. Embed second layer, subsequent layers and tapered insulation layer(s) of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
   2. Install tapered edge strips at perimeter edges.
   3. At roof drains, use field-trimmed boards to slope down to roof drains over distance of 18 inches.
   4. Place tapered insulation in slope pattern in accordance with manufacturer's instructions.
   5. Lay boards with edges in moderate contact without forcing. Cut insulation to fit perimeter blocking and around roof penetrations.
   6. Stagger joints 6 inches minimum between layers of insulation.
   7. Apply low-rise foam insulation at penetrations and at seams between insulation boards.
   8. Tape insulation joints in accordance with roofing and insulation manufacturers' instructions.

E. Vapor Retarder: Install in accordance with manufacturer's instructions.

1. Extend vapor retarder under cant strips and extend blocking to deck edge.
2. Install flexible flashing to air seal wall; lap and seal to provide air barrier continuity.

F. Walkways: Install in accordance with manufacturer's instructions.

G. Flashing: Install in accordance with manufacturer's instructions.

H. Around roof penetrations (pipe); provide compatible rubber boot, seal flanges and flashings with flexible flashing. Install stainless-steel draw band at rubber boot and tighten.

I. Around roof penetrations (curb); seal around metal flanges and metal curb flashings with flexible flashing.

J. Around roof drains; seal around metal flanges with flexible flashing.

K. Coordinate installation of roof drains and sumps and related flashings.

3.4 REPAIR

A. Touch up, repair, or replace damaged finishes in manner indistinguishable from undamaged components.

3.5 CLEANING

A. Clean roofing and other surfaces soiled by work of this section in accordance with surface manufacturer's instructions.

3.6 PROTECTION

A. Protect installed roofing and flashings from subsequent construction operations.

B. Do not permit traffic over completed roof membrane. Where unavoidable, protect surfaces from damage.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including other items indicated in Schedule and other items indicated in Schedule.

B. Sealants for joints concealed within sheet metal fabrications.

1.2 RELATED REQUIREMENTS

A. Section 04 20 00 – Masonry Accessories: Through-wall sheet metal flashings.

B. Section 07 21 00 - Thermal Insulation: Sheet metal flashing integral with thermal insulation.

C. Section 07 27 00 - Air / Vapor Barriers: Sheet metal flashing integral with air / vapor barriers.

D. Section 07 54 19 - Polyvinyl-Chloride (PVC) Roofing: Sheet metal flashing and trim integral with roofing membrane.

1.3 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

E. CDA A4050 - Copper in Architecture - Handbook; Current Edition.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.6 MOCK-UPS

A. Construct flashings as part of Mock-Up construction indicated in Division 04, Unit Masonry.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Anodized Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 20 gauge, 0.032 inch thick; clear anodized finish.
   1. Clear Anodized Finish: AAMA 611, AA-M12C22A41, Class I, clear anodic coating not less than 0.7 mil, 0.0007 inch thick.

B. Pre-Finished Aluminum: ASTM B209/B209M; 18 gauge, 0.040 inch thick; plain finish shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; pretreated metal with two-coat system including primer and color coat with at least 70 percent PVDF coating.
   2. Color: As selected by Architect from manufacturer's standard colors.

C. Stainless Steel: ASTM A666/A666M, Type 304 alloy, soft temper, 26 gauge, 0.018 inch thick; smooth No. 4 - Brushed finish.

2.2 FABRICATION - GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Form sections true to shape, accurate in size, square, and free from distortion or defects.

D. Fabricate cleats of same material as sheet, minimum 3 inches wide, interlocking with sheet.
   1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual” for application but not less than thickness of metal being secured.

E. Form pieces in longest possible lengths.

F. Hem exposed edges on underside 1/4 inch; miter and seam corners.

G. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

H. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

I. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

J. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.3 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Metal Roof Cap Flashing: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections.

2.4 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high end dams. Fabricate from the following material:
   1. Hemmed edge where flashing extends past wall system.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.

B. Primer Type: Zinc chromate.

C. Concealed Sealants: Non-curing butyl sealant.
   1. Do not use butyl sealants when they could come into contact with silicone materials. Use silicone sealants in such an event.

D. Termination Bars: Aluminum; compatible with membrane and adhesives.

E. Exposed Sealants: Refer to Division 07, Joint Sealants.

F. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

G. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

H. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

J. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
   1. Back paint / coat side of uncoated aluminum, and stainless-steel metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction. Back paint / coat to a minimum dry film thickness of 15 mil, 0.015 inch.
   2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
   3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true and straight in planes, lines accurate to profiles and levels indicated. Fit flashings tight in place; make corners square and provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
   1. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

H. Seal joints with elastomeric sealant as required for watertight construction.
   1. Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
   2. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
   3. Prepare joints and apply sealants to comply with requirements in Division 07 Section, Joint Sealants.

I. Install starter and edge strips, and cleats before starting installation.

J. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction, and as follows:
   1. Secure receiver at perimeter of wall opening with adhesives or fasteners.
   2. Place flashing into receiver channel.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.
   1. Secure in a waterproof manner by means of anchor and washer at 36-inch centers.

C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof.
   1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
   1. Lap sheets per SMACNA recommendations.

3.6 FIELD QUALITY CONTROL

A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.8 SCHEDULE

A. Anodized Aluminum: Flashing in conjunction with curtainwall systems, aluminum-framed entrances, sliding and folding glazed walls and doors and all other clear anodized aluminum components / systems.

B. Stainless Steel: Through-wall flashings.

C. Pre-Finished Aluminum: Metal cap flashings and roof-penetration flashings.

END OF SECTION

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof hatches.

1.2 RELATED REQUIREMENTS

A. Section 05 51 33 Metal Ladders: Metal ladders accessing roof hatches.

B. Section 07 54 19 Polyvinyl-Chloride (PVC) Roofing: Roof membrane system.

C. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.3 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; Current Edition.

B. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Maintenance requirements.

B. Shop Drawings: Plans and sections illustrating hatch construction, installation methods and project-specific details.

C. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
   3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit or void the roofing warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.6 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ROOF HATCHES

A. Roof Hatch Manufacturers:
   1. Babcock-Davis.
   2. Bilco Company.
   3. FAKRO America LLC.
   4. LMCurbs.

B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers unless otherwise indicated.
   2. Mounting Substrate: Provide frames and curbs suitable for mounting on standing seam metal roof panel system.
   3. Thermally Broken Hatches: Provide insulation within frame and cover.
   4. For Ladder Access: Single leaf; 30 by 36 inches.

C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch thick.
   2. Insulation: Manufacturer's standard; 3 inch rigid polyisocyanurate, located on outside face of curb.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch thick, liner 0.04 inch thick.
   3. Insulation: Manufacturer's standard 3 inch rigid polyisocyanurate.
   4. Gasket: Neoprene, continuous around cover perimeter.

E. Safety Railing System: Roof hatch manufacturer's standard accessory safety rail system mounted directly to curb.
   1. Railing: Comply with 29 CFR 1910.23 for ladder safety, with a safety factor of two.
   2. Self-Closing Gate: Comply with 29 CFR 1910.29 for safe egress and fall protection through hatch opening.
   3. Posts and Rails: Aluminum tubing.
   4. Gate: Same material as railing; automatic closing with latch.
   5. Finish: Manufacturer's standard aluminum mill finish. Rail is not to have powder coat safety-yellow finish.
   6. Fasteners: Stainless steel, Type 316.

F. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.
   4. Latch: Upon closing, engage latch automatically and reset manual release.
   5. Manual Release: Pull handle on interior and exterior.
   6. Locking: Padlock hasp on interior.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joint sealant for building joints, within 5' of building.
   1. Nonsag gunnable joint sealants.
   2. Self-leveling pourable joint sealants.
   3. Joint backings and accessories.
   4. Contractor-provided field quality control.

1.2 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).

D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

I. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.

J. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.

K. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).

L. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

M. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

N. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Substrates for which laboratory adhesion and/or compatibility testing is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   8. Certification by manufacturer indicating that product complies with specification requirements.
   9. Clearly indicate specific intended application for each sealant on the submittal.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
   1. Samples to be cured sealant samples, printed color cards will not be accepted.

D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least one physical samples for verification of color of each required sealant.

E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

H. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

I. Field Quality Control Log: Submit filled-out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

J. Manufacturer’s qualification statement.

K. Installer's qualification statement.

L. Testing agency qualification statement.

1.4 QUALITY ASSURANCE

A. Contractor will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
   1. Product suppliers or manufacturers do not qualify as Independent.

E. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
   4. Allow sufficient time for testing to avoid delaying the work.
   5. Deliver sufficient samples to manufacturer for testing.
   6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

F. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

G. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.
   2. Nondestructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
      a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 24 inches thereafter.
      b. If any failures occur in the first 10 linear feet, continue testing at 12 inches intervals at no extra cost to Owner.
   3. Field Quality Control Log: Use forms similar to those shown below:

Joint Sealant Field Quality Control Log - Field Adhesion Testing						
Sealant Manufacturer and Model #:						
Project Name:						
Date/ Time	Temperature/ Humidity	Testers Initials	Location	Proper Joint Profile and Backing (Y/N)	Visual Inspection (Pass/Fail)	Non-Destructive Test (Pass/Fail)

H. Field Adhesion Test Procedures:

1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
5. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

I. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Continuous Method.
1. Record results on Field Quality Control Log.
2. Repair failed portions of joints.

J. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.5 WARRANTY

A. Manufacturer Warranty: Provide 5-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Nonsag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
1. Dow.
2. Pecora Corporation.
3. Sherwin-Williams Company.
4. Sika Corporation.
5. Tremco Commercial Sealants & Waterproofing.
6. Substitutions: As approved to be equal by Architect.

B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
1. Pecora Corporation.
2. Sherwin-Williams Company.
3. Sika Corporation.
4. W.R. Meadows, Inc.
5. Substitutions: As approved to be equal by Architect.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints:
a. Seal open joints except open joints indicated on drawings as not sealed or joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
b. Do not seal:
1) Intentional weep holes and flashing in masonry.
2) Intentional weep holes in curtain wall or storefront.

3) Intentional weep holes in cladding systems.
2. Interior Joints:
a. Do not seal gaps and openings in gypsum board and suspended ceilings
b. Seal open joints except specific open joints indicated on drawings as not sealed.
c. Seal joints between dissimilar materials, including but not limited to:
1) Joints between counter top and backsplash.
2) Joints between plumbing fixtures and walls, counters, and floors.

B. Exterior Joints: Use non-sag non-staining silicone sealant, NSTS1, unless otherwise indicated.

C. Interior Joints: Use non-sag acrylic emulsion latex sealant, NSAL1, unless otherwise indicated.
1. Type NSAL1 - Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
2. Type NSAL2 - In Sound-Rated Assemblies: Acrylic latex sealant.

D. Interior Wet Areas: Bathrooms, restrooms, food service areas, and kitchenetts; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
1. Type MRS1 - Mildew-Resistant silicone.

E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.3 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.4 NONSAG JOINT SEALANTS

A. Type NSTS1 - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: 15-30, Shore A, when tested in accordance with ASTM C661.
5. Color: To be selected by Architect from manufacturer's standard range.
a. Architect may choose up to five separate colors.
6. Cure Type: Single or Multi-component.
7. Service Temperature Range: Minus 20 to 180 degrees F.
8. Products:
a. Dow; DOWSIL 790 Silicone Building Sealant.
b. Pecora Corporation; 890FTS.
c. Sika Corporation; Sikasil WS-290.
d. Tremco Commercial Sealants & Waterproofing; Spectrem 4-TS.

B. Type MRS1 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: Match adjacent finished surface.
2. Products:
a. Pecora Corporation; Pecora 898 NST (Non-Staining Technology).
b. Sika Corporation; Sikasil GP.

C. Type NSAL1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: Painted or tinted to match adjacent surfaces. Where surfaces are not painted, colors as selected by Architect.
2. Products:

a. Pecora Corporation; AC-20 +Silicone.
b. Sherwin-Williams Company; 850A Acrylic Latex Caulk.
c. Tremco Commercial Sealants & Waterproofing; Tremflex 834.

D. Type NSAL2 – Acrylic Latex: ASTM C920; for use as acoustical sealant in through penetrations.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Products:
a. Pecora Corporation; AC-20 FTR.

E. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.
1. Products:
a. Pecora Corporation; Pecora BA-98 Non-Skinning Butyl Sealant.
b. Tremco Commercial Sealants & Waterproofing; Acoustical/Curtainwall Sealant.

2.5 SELF-LEVELING SEALANTS

A. Self- Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Color: To be selected by Architect from manufacturer’s standard range.
3. Service Temperature Range: Minus 40 to 180 degrees F.
4. Products:
a. Sherwin-Williams Company; Stampede 1SL Polyurethane Sealant or Stampede 2SL Polyurethane Sealant.
b. Sika Corporation; Sikaflex-1c SL or Sikaflex-2c SL.

B. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Color: To be selected by Architect from manufacturer’s standard range.
3. Service Temperature Range: Minus 40 to 180 degrees F.
4. Products:
a. Pecora Corporation: Urexpan NR-200.

2.6 ACCESSORIES

A. Sealant Backing Rod, Closed-Cell Type:
1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
2. Size: 25 to 50 percent larger in diameter than joint width.
3. For uses not subject to pedestrian or vehicular traffic.

B. Sealant Backing Rod, Open-Cell Type:
1. Cylindrical flexible sealant backings complying with ASTM C1330 Type O.
2. Size: 25 to 50 percent larger in diameter than joint width.
3. For use at "blind" joints only.

C. Sealant Backing Rod, Bi-Cellular Type:
1. Cylindrical flexible sealant backings complying with ASTM C1330 Type B.
2. Size: 25 to 50 percent larger in diameter than joint width.
3. For use subject ot pedestrian or vehicular traffic.

D. Backer Rod Sizing: Doubling or use of multiple joint backers to fill joint width is prohibited.

E. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

F. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

G. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

H. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
3. Record each test on Preinstallation Adhesion Test Log as indicated.
4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Joint Cleaning: Clean out joints immediately before installing joint sealants to comply with sealant manufacturer’s written instructions, inclusive of:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing bond with joint sealants. Remove loose particles remaining after cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Solvent clean all surfaces to receive sealant, following the manufacturer’s recommendations. Protect adjacent building envelope components from exposure to the cleaners.
3. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Protect adjacent building envelope components from exposure to the cleaners.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.3 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
   1. Doubling or use of multiple joint backers to fill joint width is prohibited.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.4 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.5 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION

SECTION 079200.01 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.2 WORK INCLUDED:

A. Provide all labor, materials, necessary equipment, and services to complete the Joint Sealants work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS."

B. Related Work Specified Elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 SAMPLES AND CERTIFICATES:

A. Submit the Following Samples:

Quantity	Size	Description
3	6" long	Filler for polyurethane
3	Color sample charts	Polyurethane sealants

B. Submit the Following Certificates for Compliance:

Description	Standards
Polyurethane (two components) Class 25	Per Specifications (TT-S-00227E, Type Class A ASTM C-920, TYPE M, Grade NS (non-sag)/SL (self-leveling),

1.4 COOPERATION:

A. Work of this section shall be provided and coordinated as required through procedures of construction that will insure safety.

1.5 GUARANTEE:

A. Furnish written guarantee for all sealant work stating that said work shall be free from any defects of material and/or workmanship for a period of five (5) years, commencing on the date of final completion and acceptance.

B. Said Guarantee Shall Further State that Sealants are Guaranteed Against:

1. Adhesive or cohesive failure of sealants in joints where movement is under maximum of ±25% extension or ±25% compression for two component polyurethane base sealant.
2. Any crazing greater than 3 mils in depth developing on the surface of the sealant material.
3. Any staining of the surfaces adjacent to the joints, by the sealants, primers, or joint filler materials, by migration through the adjacent materials in contact with them.
4. Any puncture, abrasion or tear failure due to pedestrian or vehicular traffic in self-leveling polyurethane base sealant installed at traffic surfaces.
5. Any visible chalking or color change on the cured surface of the sealant.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S AND MATERIALS:

A. Multi component chemically curing, polyurethane base sealant shall be manufactured to meet the specified requirements by the following manufacturer:

1. Sika Corp., Contact: Bob Woodhouse, Manufacturer's Representative, (616) 437-7506, rwoodhouse@restorationtechinc.com

B. Manufacturer's label shall indicate the expiration date of use of sealants or manufacturer shall otherwise attest to the date of manufacture. The period of time lapsed shall not be longer than six (6) months for polyurethane from the date of manufacturer to the date of usage on the job.

C. Primers where required shall be as recommended by the sealant manufacturer.

D. The color of sealants shall be as selected by Owner's Representative and Landscape Architect or as called for on drawings.

E. Bond-breakers where required shall be as recommended by the sealant manufacturer.

2.2 HORIZONTAL EXPANSION JOINTS: (Subject to Vehicular or Pedestrian Traffic):

A. Sealant at horizontal joints of self-leveling consistency, meeting or equal to requirements specified by the following manufacturer:

1. Sikaflex – 2C SL, two component, self-leveling, polyurethane elastomeric sealant per Fed. Spec. TT-S-00227E, Type 1, Class A, ASTM C-920 Type M, Grade P, Class 25.FILLER MATERIAL FOR VERTICAL AND HORIZONTAL JOINTS:

B. Filler material shall be a non-impregnated closed-cell, supporting type, compressible resilient, free from tar, asphalt, oil and other foreign substances. Filler shall be a closed-cell polyethylene foam, or isomeric polymer foam (polystyrene will not be allowed). Filler shape shall be such that sealant in joint is fully supported against puncture or pressure, but of design to prevent sealant from being forced out of joint by contraction. Filler shall have characteristics of not bonding with sealant, surface of filler. Filler shall be at least 25% wider than width of joint measured in field to which it is applied. Compression on such installed filler shall be sufficient so as to allow no displacement.

1. Closed-cell polyethylene joint filler foam backer rod material shall comply with ASTM D-1622.
2. Where joint design, or depth of joint will not permit the use of joint backing, a bondbreaker tape must be installed to prevent three-sided adhesion. An adhesive backed polyethylene tape should be used.

2.3 EXPANSION JOINT CAPS:

A. Removable expansion joint caps manufactured by:

1. Contie
2. Greenstreak

B. Used with expansion joint filler, ready for sealant after removal.

PART 3 - EXECUTION

3.1 JOINT DIMENSIONS:

A. The depth of a joint is defined as the distance from the outside face of the joint to closest point of joint filler, whether joint is rod shaped.

B. Minimum size of joint should be four times the anticipated movement. Minimum joint dimension is 3/8" (9.5mm) x 3/8" (9.5mm), to allow for adequate cleaning and priming.

C. For joints 1/2" (13mm) and wider, the depth of the sealant should be no more than 1/2" (13mm) deep.

D. Joints to receive sealants shall be never less than 1/4" depth by 1/4" width.

E. Joints larger than the above stated minimum dimensions shall be provided in accordance with manufacturer's standard printed specifications and recommendations.

F. The Owner’s Representative and Landscape Architect shall determine and provide joints of dimensions as specified herein before.

3.2 JOINT INSPECTION:

A. Inspect all joints which are to receive work of this section and notify Owner’s Representative and Landscape Architect of dimensions and/or any existing conditions which will prevent satisfactory installation and performance of the sealants.

B. Commencement of work on any joint shall be considered full acceptance of dimensions and condition of said joint.

C. Joints to be sealed shall be thoroughly cleaned of mortar or any other foreign material in an approved manner before any sealant materials are applied. Any coating from metal surfaces shall be removed by use of solvent recommended by manufacturer of metal. Solvent shall not be allowed to air dry without wiping.

D. Concrete and masonry surfaces shall be fully cured, free of release agents, curing compounds, loose aggregate and other surface treatments. Treated surfaces shall be tested for adhesion before proceeding with sealant work.

E. Joint spaces and surfaces shall be thoroughly dry before installation of sealant materials. Unless approved means of drying joint is employed, do not install sealant material when temperature is below 40 degrees F or during and after rain and fog. To test for free moisture, run paper towel or paper napkin through joint. Paper shall be completely dry. Any alkaline seepage from fresh concrete shall be washed away, surface dried.

3.3 GENERAL WORKMANSHIP AND APPLICATION:

A. Use thoroughly experienced workmen in the application and as per manufacturer's recommendations.

B. Primer shall be used as it comes from can, unadulterated. Apply as per manufacturer's printed directions and/or recommendations. Prime joints before insertion of joint filler material.

C. Fill joint with filler material so that depth and width of joint have relationships as noted hereinafter under "Joint Dimensions".

D. When installing rod stock filler, roll filler into joint. Rod filler in final position shall not be twisted.

E. Bond-breaker strip shall be used in joints where sufficient room for back-up does not exist.

F. In mixing sealant compound components, do not whip excessive air into said materials. Mix strictly as recommended by manufacturer.

G. Sealant materials shall be applied within "application life" recommended by manufacturer for prevailing temperature and humidity conditions. Do not retemper.

H. Protect exposed surfaces adjacent to joints to prevent permanent staining or other damage to adjacent work. Be fully responsible for any staining and/or other damage caused under work of this section to any adjacent work.

I. If manufacturer indicates there is any possibility of color of sealant material being changed by use of wetting agents while tooling, Contractor shall dry tool.

J. Joints shall be lightly tooled into place immediately after application, when necessary to give concave shaped surface.

K. Immediately after application of sealants, thoroughly clean adjacent surfaces which may have been soiled, as per sealant manufacturer recommendations. Leave work in neat and clean conditions to full satisfaction of Owner's Representative and Landscape Architect.

3.4 GENERAL PERFORMANCE:

A. Sealants: Except as otherwise indicated, joints are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application. Failures of installed sealants to comply with these requirements will be recognized as failures of materials and workmanship.

END OF SECTION 079200.01

SECTION 08 12 13 - HOLLOW METAL FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal frames for non-hollow metal doors.

1.2 RELATED REQUIREMENTS

A. Section 08 14 05 – Architectural Wood Doors: Non-hollow metal doors for hollow metal frames.

B. Section 08 71 00 - Door Hardware: Hardware, silencers, and weatherstripping.

1.3 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. HMMA: Hollow Metal Manufacturers Association.

C. NAAMM: National Association of Architectural Metal Manufacturers.

D. SDI: Steel Door Institute.

1.4 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

H. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

J. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

K. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

L. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

M. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

1.5 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

C. Manufacturer's Qualification Statement.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide hollow metal frames from SDI Certified manufacturer: https://steeldoor.org/sdi-certified/#sle.

1.7 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Frames:
1. Ambico Ltd.
2. Ceco Door, an Assa Abloy Group company.
3. Republic Doors, an Allegion brand.
4. Steelcraft, an Allegion brand.
5. Pioneer Industries.
6. Technical Glass Products.

2.2 PERFORMANCE REQUIREMENTS

A. Refer to Door and Frame Schedule on drawings for frame sizes, finishing, door hardware to be installed, and other variations, if any.

B. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.

C. Accessibility: Comply with ICC A117.1 and ADA Standards.

D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame

that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.

E. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

2.3 HOLLOW METAL DOOR FRAMES

A. Frame Finish: Factory primed and field finished.

B. Interior Door Frames, Non-Fire Rated: Face welded type.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
         1) Provide minimum 14 gage frames at doors 106 and 107.
         2) Provide minimum 14 gage frames at doors with hold-opens.

C. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.4 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Finish Coat; Field painted, refer to Division 09, Interior Painting.

2.5 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

C. Acoustic Insulation: refer to Division 09, Gypsum Board Assemblies.

D. Wood Blocking: refer to Division 06, Rough Carpentry.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 INSTALLATION

A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Acoustic Insulation at doors installed in walls with required STC sound rating: Fill frame void at both head and jambs with acoustic insulation.

D. Wood blocking at doors 106 and 107: Install wood blocking, full width of frame by maximum depth possible at both head and jambs. Fasten wood blocking into adjacent metal stud framing.

E. Install door hardware as specified in Division 08, Door Hardware.

F. Coordinate installation of electrical connections to electrical hardware items.

G. Touch up damaged factory finishes.

3.3 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

END OF SECTION

SECTION 08 14 05 – ARCHITECTURAL WOOD DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior flush wood doors; non-rated.

1.2 RELATED REQUIREMENTS

A. Section 06 20 00 – Finish Carpentry: For wood door frames and trim.

B. Section 08 12 13 - Hollow Metal Frames.

C. Section 08 43 13 – Aluminum-Framed Storefronts.

D. Section 08 71 00 – Door Hardware.

E. Section 08 80 00 – Glazing.

1.3 REFERENCE STANDARDS

A. ANSI A208.1 – American National Standard for Particleboard; 2022.

B. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2024, with Editorial Revision (2025).

C. FM (AG) - FM Approval Guide; Current Edition.

D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. ITS (DIR) - Directory of Listed Products; Current Edition.

F. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.4 SUBMITTALS

A. Product Data: Each type of door and finish.
   1. Core and edge construction.
   2. Finishes.

B. Shop Drawings and Schedule: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, hardware preparation, factory machining, factory finishing, cutouts for glazing and other details.
   1. Use same unit designations used in Contract Documents.

C. Samples:
   1. Each required veneer species and factory finish; corner unit showing construction and finish minimum 8 by 10 inches. Sample will be retained at Architect's office and not returned to Contractor.

D. Installer’s Qualification Statement

E. Warranty, executed in Owner’s name.

F. Maintenance data.

1.5 QUALITY ASSURANCE

A. manufacturer qualifications: Company specializing in manufacturing the products specified in this section, with not less than five years of documented experience.

B. Installer qualifications: Company specializing in performing work of the type specified in this section, with not less than five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package factory-finished doors individually in manufacturer's standard plastic bags, stretch wrap, or cardboard cartons.

B. Store doors inside building in clean, dry location.

C. Mark each door on top bottom rail with opening number used on Shop Drawings.

D. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation if humidity is not maintained between 25 percent and 55 percent.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity at occupancy levels during remainder of construction period.

1.8 MANUFACTURER WARRANTIES

A. Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Warping (bow, cup, or twist) more than 1/4 inch in 42-inch by 84-inch section.
      b. Telegraphing of core construction in face veneers exceeding 0.01-inch in 3-inch span.
   2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

B. Warranty Periods:
   1. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Forte Opening Solutions – Aspiro Series.

B. Subject to compliance with requirements, equivalent products of the following manufacturers will be acceptable.
   1. Ampco Products, Inc.
   2. Graham-Maiman Wood Doors.
   3. Oshkosh Door Company.
   4. Poncraft Door Co.
   5. VT Industries, Inc.

C. Source Control: Supply all wood doors from a single manufacturer.

2.2 MANUFACTURING STANDARDS

A. Interior Flush Wood Doors: Window & Door Manufacturers Association publication ANSI/WDMA I.S. 1A "Industry Standard for Interior Architectural Wood Flush Doors".

2.3 INTERIOR SOLID CORE FLUSH WOOD DOORS – WOOD VENEER FINISH

A. Solid Core Select Wood Veneer Flush Doors:
1. WDMA Quality grade: Custom.
2. WDMA Performance Level: Heavy Duty.
3. Faces:
   a. Veneer Grade: AA.
   b. Veneer Species: As indicated on Drawings.
   c. Veneer Cut: As indicated on Drawings.
   d. Veneer Leaf Match: Book match, unless indicated otherwise on Drawings.
   e. Veneer Face Match/Assembly: Running.
   f. Veneer Finish: As indicated on Drawings.
4. Top, Bottom and Vertical Edges: Structural composite lumber, matching/compatible hardwood lumber that matches face veneer. Finish edges with clear sealer to match face veneer sheen / finish.
5. Core: Structural composite lumber (SCLC).
6. Construction: Five Plies; stiles and rails bonded to core, and entire unit is abrasive planed before veneering.
7. Thickness: 1-3/4 inch.

B. Solid Core Select Wood Veneer Flush Doors with Glazed Lites:
1. Match appearance grade and applicable construction and performance requirements of other standard veneer flush solid core wood doors.
2. Factory Glazing: Refer to Division 08, Glazing for glass view panels in flush wood doors. Factory install glass as required. Fill glazing bead nail holes in factory finished doors.
3. Wood Glazing Accessories: Solid wood of same species as face veneer in standard profile selected by Architect.
   a. Bead Profile: As selected from manufacturer standard options.

2.4 INTERIOR SOLID CORE FLUSH WOOD DOORS – PLASTIC LAMINATE FINISH

A. Solid Core Plastic Laminate Flush Doors:
1. WDMA Quality grade: Custom.
2. WDMA Performance Level: Heavy Duty.
3. Faces: High Pressure Decorative Laminate (HPDL) Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS. Laminate as indicated on Drawings.
4. Core: Structural composite lumber (SCLC).
5. Construction: Five Plies; stiles and rails bonded to core, and entire unit is abrasive planed before laminating.
6. Thickness: 1-3/4 inch.

2.5 DOOR CORE MATERIALS

A. Solid Core Doors: Type structural composite lumber core (SCLC), plies and faces as indicated; with SCLC blocking as required to provide adequate anchorage of hardware without through-bolting.

B. Structural Composite Lumber: WDMA T.M.10.

2.6 DOOR FRAMES

A. Material: Hollow Metal Frames.
1. Company with standards and/or guidelines as indicated in Division 08, Hollow Metal Frames.

B. Material: Solid Wood Frames.
1. Comply with standards and/or guidelines as indicated in Division 06, Finish Carpentry.

2.7 FABRICATION

A. Fabricate doors in accordance with door quality standards.

B. Factory Fitting: Fit to frame openings with clearances specified in WDMA I.S. 1A.
   1. Undercut: Maximum 3/8 inch (above thresholds.

C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.

D. Factory Machining: Machine doors for hardware that is not surface applied.
   1. Verify dimensions for hardware mortises in metal frames before machining.

E. Openings:
   1. Cut and trim openings and install glazing at factory.
   2. Non-removable stops on non-secure side; sizes and configurations as indicated on Drawings.

F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

G. Provide edge clearance in accordance with the quality standard specified.

2.8 FINISHES – WOOD VENEER DOORS

A. Finish Grade: Match grade of door.

2.9 ACCESSORIES

A. Hollow Metal Door Frames: Refer to Division 08, Hollow Metal Frames.

B. Aluminum Metal Door Frames: Refer to Division 08, Aluminum-Framed Storefronts.

C. Glazing: Refer to Division 08, Glazing.

D. Door Hardware: Refer to Division 08, Door Hardware.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before start of work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that door frames are plumb, square, and accurate size. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

D. Inspect each door before installation for damage and defects per WDMA Section F-6.

3.2 INSTALLATION

A. Hardware installation is conforming to Division 08, Door Hardware.

B. Install doors in accordance with manufacturer's instruction and specified quality standard. Reference Standards:
   1. Wood Doors: WDMA I.S. 1A.

C. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

D. Use machine tools to cut or drill for hardware.

E. Coordinate installation of doors with installation of frames and hardware.

F. Coordinate installation of glazing.

G. Counter-sink fasteners and sex-bolts to prevent damage to veneer.

H. Align doors with uniform vertical and top edge clearance.

3.3 REPAIR

A. Repair of damage or defects is subject to Architect's acceptance, including removal of soiling. Provide new replacement doors for doors that cannot be satisfactorily repaired.

3.4 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Complete with specified quality standard for telegraphing, warp, and squareness.

3.5 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.6 PROTECTING AND CLEANING

A. Protect installed doors from damage and soiling.

B. Clean doors shortly before inspection for Substantial Completion.

END OF SECTION 08 14 05

SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior wall and ceiling mounted access units.

1.2 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting: Field paint finish for access units.

1.3 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

1.4 SUBMITTALS

A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

B. Manufacturer's qualification statement.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

PART 2 PRODUCTS

2.1 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated.
   2. Style: Exposed frame with door surface flush with frame surface.
      a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
   3. Door Style: Single thickness with rolled or turned in edges.
   4. Frames: 16-gauge, 0.0598-inch minimum thickness.
   5. Single Steel Sheet Door Panels: 16-gauge, 0,0625-inch minimum thickness.
   6. Steel Finish: Shop primed. Field painted to match adjacent wall or ceiling finish.
   7. Door/Panel Size: as indicated on the drawings or 24" x 24" if not indicated.
   8. Hardware:
      a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
      b. Handle: No handle.
      c. Latch/Lock: Tamperproof tool-operated cam latch. Provide two tools to Owner.
      d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 32 23 - SLIDING AND FOLDING GLAZED WALLS AND DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior, glazed aluminum sliding wall panel systems, top supported,

B. Interior, glazed wood sliding wall panel systems, top supported.

C. Support and operating hardware.

1.2 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Steel lintels.

B. Section 06 10 00 - Rough Carpentry: Rough opening framing.

C. Section 07 21 00 - Thermal Insulation: Fibrous stuffing insulation at frame perimeter.

D. Section 07 25 00 - Weather Barriers: Sealing door frame to water-resistive barrier installed on adjacent construction.

E. Section 07 92 00 - Joint Sealants: Sealing joints between door frames and adjacent construction.

F. Section 08 71 00 - Door Hardware: Additional hardware.

G. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

C. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).

D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

E. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

F. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

G. ASTM E413 - Classification for Rating Sound Insulation; 2022.

H. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2023.

1.4 SUBMITTALS

A. Product Data: Provide information on dimensions, frame and sill construction, glazing, and hardware.

B. Shop Drawings: Indicate opening dimensions, elevations of different types, and framed opening tolerances.

C. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.

B. Installer Qualifications: Company specializing in installation of products of type specified, with not less than five years of documented experience.
   1. Installer must be a trained and certified installer, approved by Manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for installation.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F.
   1. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.8 WARRANTY

A. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

B. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN - ALUMINUM PANEL FRAME

A. Exterior: Bottom-Supported, Thermally Broken, Sliding-Folding Aluminum-Framed Glass Panel System with Insulating Glazing:
   1. Basis of Design: NanaWall Systems, Inc.; NW Aluminum 640.

B. Interior: Bottom-Supported, Acoustically Rated, Sliding-Folding Wood-Framed Glass Panel System with Vision Glazing:
   1. Basis of Design: NanaWall Systems, Inc.; NW Acoustical 545.

C. Other Manufacturers: Provide either product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below provided they meet the performance criteria specified:
   1. Arcadia, Inc.
   2. DORMA USA, Inc.
   3. Modernfold, a DORMA Group Company.
   4. Panda Windows and Doors.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance Requirements for Exterior and Interior Applications: (Lab Tested)
   1. Swing Panel – Operation / Cycling Performance (AMMA 920): 500,000 cycles
   2. System – Life Cycle Performance (DIN EN 1191/12400): 20,000 cycles
   3. Operating Force (ASTEM E2068):
      a. Swing Panel: Open 2.8 N (1 lbf) & Close 3.9 N (1 lbf)
      b. Folding Panel:
         1) Initiate Motion: Open 20 N (4 lbf) & Close 15 N (3 lbf)
         2) Maintain Motion: Open 3 N (1 lbf) & Close 4 N (1 lbf)
   4. Forced Entry (AAMA 1304. DIN En 1191): Pass
   5. Forced Entry Resistance (ASTM F842, AMMA 1304, CAWM 300): Meets Grade 40; +F2
   6. Unit Burglary Resistance: EN 1627-30, Class RC2/ RC2N certified

B. Performance Requirements: For units mounted in exterior walls and that require weather performance, provide systems that comply with the following:
   1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Exterior Water Penetration Resistance; Static Pressure: No uncontrolled water entry on interior face when tested in accordance with ASTM E331 at differential pressure of 5.25 lbf/sq ft.
   3. Exterior Air Leakage: 0.07 to 0.30 cfm/sq ft maximum leakage at 6.27 psf pressure difference, when tested in accordance with ASTM E283/E283M.
   4. Thermal Performance Requirements: Overall U-value, including glazing of partition, 0.40 Btu/(hr sq ft deg F), maximum.
   5. Condensation Resistance (CR): 55 minimum.

C. Performance Requirements: For units mounted in interior walls provide systems that comply with the following:
   1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Acoustical Performance: Provide glass partitions and door assemblies tested by qualified testing agency, calculated in accordance with ASTM E413, tested in accordance with ASTM E90, and rated for not less than Sound Transmission Class (STC) indicated.
      a. Partition STC Rating: 35, minimum, for framed partitions.

2.3 SLIDING AND FOLDING GLAZED DOORS AND WALLS

A. Glazed Aluminum Sliding and Pivoting Wall Panel Systems: Extruded aluminum sliding and fixed wall panel frames, factory fabricated; complete with sill, flashings, and support and anchorage devices.
   1. Configuration: Exterior, inward opening, right stacking, with locking swing panel door.
   2. Support System: Top hung.
   3. Panel Thickness: 2-5/8 inch.
   4. Top Rail Height: 2-5/8 inch, square edge.
   5. Bottom Rail Height: 2-5/8 inch, square edge.
   6. Stile Width: 1-3/4 inch, square edge.
   7. Panel Weight: 10 lbs per sq ft, maximum.
   8. Doors: Match panel rail height(s) and stile width.
   9. Aluminum Frames: Factory finished; manufacturer's standard corner construction; thermally broken.
   10. Drainage: Provide drainage to exterior for moisture entering joints and glazing spaces and for condensation occurring within frame construction.
   11. Sill: Recessed, low profile saddle sill.
   12. Glass Stops: Same material and color as frame.
   13. Aluminum Frame Finish: Class I Natural Anodized Finish in accordance with AAMA 611. Clear anodic coating not less than 0.7 mils thick. Anodized coating in accordance with AAMA 611.
      a. Exterior Color: Clear anodized
      b. Interior Color: Clear anodized

B. Glazed Wood Bi-Folding Wall Panel Systems: Solid laminated wood operable and fixed wall panels, factory fabricated; complete with flashings, and support and anchorage devices.
   1. Configuration: Inward opening, right stacking, with locking swing panel door.
   2. Support System: Floor mounted.
   3. Panel Thickness: 3-3/8 inch.
   4. Top Rail Height: 3-1/4 inch.
   5. Bottom Rail Height: 3-1/4 inch.
   6. Stile Width: 3-1/4 inch.
   7. Panel Weight: 155 pounds, maximum.
   8. Doors: March panel rail height(s) and stile width.
   9. Wood Frames: Manufacturer's standard corner construction.
   10. Sill: Recessed, flush sill.
   11. Glass Stops: Solid wood to match frame, sloped for wash.
   12. Wood: Cherry.
      a. Finger joints not permitted in transparent finished exposed surfaces.
      b. Scarf joints permitted in transparent finished exposed surfaces only if color and grain texture match.
      c. Finish: Factory finished, finish as indicated on Drawings.

C. Glazing: Refer to Division 08, Glazing.

D. Sliding Wall Panel Hardware: Manufacturer's standard hardware including carriages with sealed ball bearing rollers, and top or bottom tracks.
   1. Door Hardware: Pull handle.
   2. Locking Mechanisms: Minimum two-point deadbolt locking of each panel; manufacturer's standard type.
   3. Sill: ADA Compliant.
   4. Additional Wall Panel Hardware: Include a key locking mechanism with a cutout in outside escutcheon to accommodate cylinder; refer to Division 08, Door Hardware.
   5. Exterior Swing Door Locking: Lever handle lockset with deadbolt into jamb strike; manufacturer's standard type. Provide key cylinder on interior lever only, refer to Division 08, Door Hardware for cylinder.
   6. Interior Swing Door Locking: Lever handle lockset with deadbolt into jamb strike; manufacturer's standard type. Provide key cylinder on exterior level only, refer to Division 08, Door Hardware for cylinder.

a. Allow free egress in path of travel.
7. Exposed Hardware Finish: Stainless steel, satin / brushed chrome finish.

E. Weatherstripping: Manufacturer's standard, continuous and replaceable; provide between exterior doors, panels, frame and track.

2.4 FACTORY ASSEMBLY

A. Factory assemble sliding/folding operable panel frames as single unit, including head, jambs, and bottom sections; provide concealed fasteners.
1. Sizes: Allow for tolerances of rough framed openings, clearances, and shims at perimeter of assemblies.
2. Joints and Corners: Flush, hairline and waterproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
3. Glazing: Factory installed.

2.5 ACCESSORIES

A. Anchors: Hot-dipped galvanized or stainless steel in accordance with project and manufacturer's installation requirements.

B. Sealant for Setting Sills and End Dams: Elastomeric sealant acceptable to door manufacturer.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings are ready to receive work and opening dimensions and clearances are as indicated on approved shop drawings.

B. Verify that overhead structural supports are adequate and deflection is in compliance with manufacturer's installation requirements.

3.2 PREPARATION

A. Prepare opening to permit correct installation of door unit in coordination with air and vapor seal.

B. Apply two coats of bituminous paint with minimum of 16 mils, 0.016 inch dry film thickness (DFT), or as recommended by coating manufacturer, on concealed aluminum surfaces in contact with cementitious or dissimilar materials.
1. Allow bituminous paint to dry prior to installation of aluminum component.
2. Dipping of aluminum into bituminous paint is not permitted.

3.3 INSTALLATION

A. Install assemblies in accordance with manufacturer's instructions.

B. Install exterior doors in accordance with ASTM E2112.

C. Attach frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

D. Use anchorage devices to securely fasten assembly to adjacent construction without distortion or imposed stresses.

E. Set exterior sills in full bed of sealant, with end dams and non-blocking sill drainage openings.

F. Install shims at exterior wall sill locations and ensure water dams are not created and sill weep openings are not blocked due to shim placement and orientation.

G. Provide sealed end dams at exterior wall locations.

H. Install perimeter trim and interior closures.

I. Touch up damaged factory finishes for coated or painted materials.

3.4 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation from Plumb: 1/16 inch.

C. Maximum Variation from Level: 1/16 inch.

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 feet straight edge.

3.5 ADJUSTING

A. Adjust hardware for smooth operation.

3.6 CLEANING

A. Remove protective material from factory finished surfaces.

B. Remove labels and visible markings.

C. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.

D. Upon completion of installation, thoroughly clean door aluminum surfaces in accordance with AAMA 609 & 610.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 39 00 – ATTIC ACCESS DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Attic access hatch with integral folding ladder.

1.2 RELATED REQUIREMENTS

A. Section 05 52 13 Pipe and Tube Railings: Railings around attic openings.

1.3 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; Current Edition.

B. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Maintenance requirements.

B. Shop Drawings: Plans and sections illustrating hatch construction, installation methods and project-specific details.

C. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
   3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit or void the roofing warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.6 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ATTIC HATCHES WITH LADDER

A. Attic Hatch Manufacturers:
   1. FAKRO America LLC.

2. Precision Ladders.
3. Werner Co.
4. Approved equal as determined by Architect.

B. Attic Hatches with Ladders: Factory-assembled attic hatch and ladder with wood or metal frame to enclose and support the ladder with flat lower (interior cover), complete with operating and release hardware.
1. Size: 30 inches by 54 inches.
2. Loading: 350 pounds minimum.
3. Mounting: Provide wood or metal frames suitable for side wall mounting to floor joists.
4. Folding Ladder Access: Metal, triple section ladder, with lower (interior) door
5. Ladder Room Height Range: 12’-0” to 10’-0”. Field modify ladder to accommodate final height.
6. Hardware: Non-locking with pull down cord with handle or manufacturer supplied separate pull down rod.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior swing aluminum doors in aluminum curtain walls.

B. Interior swing aluminum doors in aluminum storefront systems.

1.2 RELATED REQUIREMENTS

A. Section 08 43 13 – Aluminum-Framed Storefronts: Aluminum entrance doors in interior storefront systems.

B. Section 08 44 13 – Glazed Aluminum Curtain Walls: Entrance doors in exterior aluminum curtainwall systems.

C. Section 08 71 00 - Door Hardware.

A. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

A. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.

D. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

E. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

F. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

G. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

H. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

I. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

K. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

N. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

O. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

P. ASTM E413 - Classification for Rating Sound Insulation; 2022.

Q. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

R. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

S. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers, including but not limited to Sliding and Folding Glazed Wall and Door installer.

1.5 SUBMITTALS

A. Product Data: Plans and elevations including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

C. Installer’s Qualification Statement.

D. Manufacturer’s Qualification Statement.

E. Welder’s Qualification Statement.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

G. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
   1. For aluminum entrances, provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
      a. North American Contractor Certification (NACC) for glazing contractors.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.

C. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Single-Source Responsibility: Storefront framing, aluminum entrance doors, and curtainwall framing is to supplied from the same manufacturer and installed by the same Trade Contractor regardless of Section where the items are specified.

B. The Drawings and dimensional relationships shown therein are based on the Basis of Design product. The Contractor assumes the costs, design, and coordination responsibilities associated with dimensional differences that may be inherent between the Basis of Design system and systems available from "Other Manufactures" allowed by this Specification Section.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work, must be same manufacturer as Aluminum Curtain Wall Manufacturer and include, but are not limited to, the following:

   1. Basis of Design:
      a. Exterior Entrance Doors: Kawneer, 500T Insulpour Thermal Entrance.
      b. Interior Vestibule Entrance Doors: Kawneer, 500 Heavy Wall Entrance.
   2. Oldcastle Building Envelope.
   3. Tubelite Inc.
   4. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: High-performance plastic connectors separate framing members exposed to the exterior from members exposed to the interior.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads fabricated from stainless steel.

D. Concrete Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08, Glazing.

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.5 DOORS

A. Performance Requirements:

1. General Performance (Exterior Doors): Aluminum-framed entrance system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
2. Wind Loads: Comply with the more stringent of the requirements of ASCE 7 and the loads shown on the Structural Drawings.
3. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 7.5 psf.
4. Air Leakage:
   a. For butt-hung entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E283 at a pressure differential of 1.57 psf for single doors.
   b. A single entrance door and frame shall not exceed 1.0 cfm/ft².
5. Uniform Load:
   a. A static air design load shall be applied in the positive and negative direction in accordance with ASTM E330: 70 psf for single doors.
   b. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
6. Thermal Performance Requirements:
   a. Overall U-value including Glazing: 0.54 Btu/(hr sq ft deg F), maximum.
   b. Condensation Resistance Factor: 45, minimum for framing and 65 minimum for glazing, measured in accordance with AAMA 1503.
7. Forced Entry: Performance shall be tested in accordance with AAMA 1304.

B. Doors: Manufacturer's standard glazed doors, for manual swing operation.

1. Door Construction Exterior: 2 1/4-inch minimum overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
   a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Construction Interior: 2-inch minimum overall thickness, with minimum 0.1875-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
3. Door Design: Wide stile; 5-inch nominal width
   a. Rail Design: Upper rail, minimum of 5-inch height. Bottom rail, minimum of 12-inch height.
4. Glazing Stops and Gaskets: Beveled snap-on, extruded-aluminum stops and preformed gaskets.
   a. Provide nonremovable glazing stops on outside of door.

2.6 DOOR HARDWARE

A. Door Hardware: As specified in Division 08, Door Hardware.

2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07, Joint Sealants.

2.8 FABRICATION

A. Form aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.

F. Doors: Reinforce doors as required for installing hardware.

1. At exterior doors, provide weather sweeps applied to door bottoms.

G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.

H. After fabrication, clearly mark components to identify Project and their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

C. Touch-UP Materials: As recommended by coating manufacturer for field application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify dimensions, tolerances, and method of attachment with other related work.

C. Verify that curtain wall openings are ready to receive work of this section

D. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Each frame leg will be anchored to the floor with two 1/4 inch minimum diameter cadmium plated machine screws in steel expansion shields anchors. Ramset or hand-set concrete nails are unacceptable. If the middle stretcher should need to be removed for access during construction, it will be reinstalled and the frame checked for alignment before anchoring to the wall.

E. Set continuous sill members and flashing in full sealant bed to produce weathertight installation. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Install glazing as specified in Division 08, Glazing.

G. Entrances: Install to produce smooth operation and tight fit at contact points.

1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:

   a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
   b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.3 ADJUSTING

A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.

END OF SECTION 08 41 13

SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed interior storefront systems with vision glazing.

B. Aluminum interior doors and frames.

1.2 RELATED REQUIREMENTS

A. 08 14 05 – Architectural Wood Doors: Wood swing doors in storefront system.

B. 08 41 13 – Aluminum-Framed Entrances: Aluminum swing doors in storefront system.

C. Section 08 71 00 - Door Hardware.

D. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

C. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

J. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of exterior curtain walls where interior storefront abuts curtain wall systems.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

C. Manufacturer's qualification statement.

D. Installer's qualification statement.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
   1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
      a. North American Contractor Certification (NACC) for glazing contractors.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

A. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with installer.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Single-Source Responsibility: Storefront framing, aluminum entrance doors, and curtainwall framing is to supplied from the same manufacturer and installed by the same Trade Contractor regardless of Section where the items are specified.

B. The Drawings and dimensional relationships shown therein are based on the Basis of Design product. The Contractor assumes the costs, design, and coordination responsibilities associated with dimensional differences that may be inherent between the Basis of Design system and systems available from "Other Manufactures" allowed by this Specification Section.

2.2 BASIS OF DESIGN -- STOREFRONT FRAMING

A. Center-Set Style, Not Thermally-Broken:
   1. Basis of Design: Kawneer TriFab VersaGlaze 451 Framing System, Center Glazed.
      a. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
   1. Oldcastle Building Envelope.
   2. YKK AP America Inc.
   3. Tubelite Inc.

2.3 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Rabbet: As required for the glazing thickness indicated.
   2. Fabrication: Joints and corners flush, hairline, and accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   4. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
   5. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   6. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
   1. Member Deflection: Design and size components to withstand the specified load requirements, without damage or permanent set, as required in applicable codes and as indicated in Structural Drawings, whichever is greater. Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Lateral Loads: Design and size components to withstand the specified load requirements as required in applicable codes and as indicated in Structural Drawings, whichever is greater.
   3. Sound Transmission Class Rating: Provide STC 35 rating for combined aluminum storefront framing system and storefront glazing. Refer to glazing specification for required glass STC rating.

2.4 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections.
   1. Framing members for interior applications need not be thermally broken.
   2. Glazing Stops: Flush.
   3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: Refer to Division 08 Glazing for vision glazing.

C. Head Receptors: As required for deflections exceeding 3/4 inch. Finish to match framing members.

D. Swing Doors: Glazed aluminum or wood doors. Refer to Division 08, Architectural Wood Doors and Division 08, Aluminum-Framed Entrances.
   1. Glazing Stops: Square.

2.5 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

D. Structural Supporting Anchors Attached to Structural Steel: Design for welded attachment.

E. Fasteners: Stainless steel; type as required or recommended by storefront manufacturer.

F. Sealant for Setting Thresholds: Non-curing butyl type.

G. Exposed Sealants: As specified in Division 07, Joint Sealants.

H. Glazing Gaskets: Type to suit application to achieve design criteria.

I. Glazing Accessories: As specified in Division 08, Glazing.

J. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.6 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.7 HARDWARE

A. Door Hardware: As specified in Division 08, Door Hardware.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.2 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Install hardware using templates provided.

F. Install glass and infill panels using glazing method required to achieve performance criteria, refer to Division 08, Glazing.

G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Storefront Mullions and Adjacent Construction: Maximum of 1/2 inch and minimum of 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

3.5 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and spandrel glazing.

1.2 RELATED REQUIREMENTS

A. Section 08 41 13 - Aluminum-Framed Entrances: Swing doors in exterior curtainwall systems.

B. Section 08 71 00 - Door Hardware.

C. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

A. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.

D. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

E. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

F. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

G. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

H. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

I. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

K. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

N. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

O. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

P. ASTM E413 - Classification for Rating Sound Insulation; 2022.

Q. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

R. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

S. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers, including but not limited to Sliding and Folding Glazed Wall and Door installer.

1.5 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, and glazing.

B. Shop Drawings: Plans and elevations Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
   1. Include the design engineer's seal and signature on each sheet of the shop drawings.

C. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.

D. Designer's Qualification Statement.

E. Manufacturer's Qualification Statement.

F. Installer’s Qualification Statement.

G. Testing Agency Qualification Statement.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.

C. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
   1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
      a. North American Contractor Certification (NACC) for glazing contractors.

1.7 MOCK-UPS

A. Construct mock-up, 8 feet long by full height, indicating each component being used on the project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

B. Approved mock-up will become standard for appearance and workmanship.

C. Mock-up may remain as part of work.

D. If mock-up is not incorporated into the work, remove and dispose of debris.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.9 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with installer.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN - CURTAIN WALL SYSTEMS

A. Single-Source Responsibility: Storefront framing, aluminum entrance doors, and curtainwall framing is to supplied from the same manufacturer and installed by the same Trade Contractor regardless of Section where the items are specified.

B. The Drawings and dimensional relationships shown therein are based on the Basis of Design product. The Contractor assumes the costs, design, and coordination responsibilities associated with dimensional differences that may be inherent between the Basis of Design system and systems available from "Other Manufactures" allowed by this Specification Section.

C. Pressure Cap at Four Sides; High Thermal Performance:
   1. Basis of Design: Kawneer, an Arconic Company; 1600UT.
      a. Frame Size: 2-1/2 inches wide by 7-1/2 inches deep.
      b. Pressure Plate Profile: Use manufacturer standard ‘square’ profile.

D. Other Manufacturers: Provide either product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below.
   1. Oldcastle Building Envelope.
   2. YKK AP America Inc.
   3. Tubelite Inc.

2.2 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Fabrication Method: Shop/factory unit and mullion system.
   2. Glazing Method: Either shop/factory or field glazed system.
   3. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   6. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of vision glazing, spandrel glazing and heel bead of glazing compound.
   7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the more stringent of the requirements of ASCE 7 and the loads shown on the Structural Drawings.
      a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
      b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
   2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.

3. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
4. Movement: Accommodate the following movement without damage to components or deterioration of seals:
   a. Expansion and contraction caused by 180 degrees F surface temperature.
   b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
   c. Movement of curtain wall relative to perimeter framing.
   d. Deflection of structural support framing, under permanent and dynamic loads.
   e. Mid-span slab edge deflection of 3/4 inch.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
1. Test Pressure Differential: 20 psf.
2. Test Method: AAMA 501.1.

D. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.24 psf pressure difference across assembly.

E. Thermal Performance Requirements:
1. Condensation Resistance Factor of Framing: 70, minimum, measured in accordance with AAMA 1503.
2. Overall U-Value Including Glazing:
   a. At Vision Glazing: 0.40 Btu/(hr sq ft deg F), maximum.
   b. At Spandrel Glazing: 0.43 Btu/(hr sq ft deg F), maximum.

F. Acoustical Performance Requirements:
1. Sound Attenuation: STC of 35, minimum, from exterior to interior.

2.3 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Pressure Plates:
1. Aluminum.

C. Glazing: Refer to Division 08 Glazing for vision glazing and spandrel glazing.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

D. Structural Supporting Anchors Attached to Structural Steel: Design for welded attachment.

E. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

F. Exposed Flashings: At curtain wall sills, aluminum sheet, 20-gauge, 0.032-inch minimum thickness; finish to match framing members.

G. Concealed Flashings: Sheet aluminum, 26-gauge, 0.017-inch minimum thickness.

H. Sealant for Setting Thresholds: Non-curing butyl type.

I. Exposed Sealant: As specified in Division 07, Joint Sealants.

J. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

K. Glazing Accessories: As specified in Division 08, Glazing.

L. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.5 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

G. Install sill and end dam flashings to from water tight dam as indicated on drawings and as recommended by curtainwall manufacturer.

H. Set thresholds in bed of sealant and secure.

I. Provide single-component low-rise spray foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

J. Install hardware using templates provided.
   1. Refer to Division 08 Door Hardware, for hardware installation requirements.

K. Install glass and infill panels using glazing method required to achieve performance criteria, refer to Division 08, Glazing.

L. Install pressure caps with fasteners by hand tool tightening to manufacturer psi torque requirements.

M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet noncumulative or 0.5 inches per 100 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 1/2 inch and minimum of 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.

3.5 ADJUSTING

A. Adjust operating sash for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Laminated glass interlayers.

D. Glazing compounds.

1.2 RELATED REQUIREMENTS

A. Section 08 32 23 - Sliding and Folding Glazed Walls and Doors: Glazing provided as part of a sliding and flodring glazed wall and door assembly.

B. Section 08 41 13 - Aluminum-Framed Storefronts: Glazing provided as part of entrance doors.

C. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

D. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing provided as part of wall assembly.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

F. ASTM C1036 - Standard Specification for Flat Glass; 2021.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2024, with Editorial Revision (2025).

I. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

M. GANA (GM) - GANA Glazing Manual; 2022.

N. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.

O. GANA (SM) - GANA Sealant Manual; 2008.

P. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).

Q. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

R. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

S. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.4 SUBMITTALS

A. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

C. Samples: Submit one sample 12 by 12 inch1 in size of glass units. Sample will be retained at Architect's office and not returned to Contractor.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods.

B. Manufacturer and Fabricator Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for installation.

B. Protect finished surfaces with strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to glazing when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

A. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

B. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Float Glass Manufacturers:
1. Basis of Design (exterior glazing): Vitro Architectural Glass (formerly PPG Glazing).
2. AGC glass North America, Inc.
3. Guardian Glass, LLC.
4. Pilkington North America Inc.
5. Saint Gobain North America.

2.2 PERFORMANCE REQUIREMENTS – GENERAL

A. Provide fully tempered safety glazing at all hazardous locations required by applicable codes and authority having jurisdiction.

2.3 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
1. Design Pressure: Calculated in accordance with ASCE 7.
2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
4. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. To utilize inner pane of multiple pane insulating glass units for continuity of vapor retarder and/or air barrier seal.
   2. To maintain a continuous vapor retarder and/or air barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.4 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
   5. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
   2. Polyvinyl Butyral (PVB) Interlayer: Thickness as noted in glass type.

2.5 INSULATING GLASS UNITS

A. Manufacturers:
   1. Glass: Any of the manufacturers specified for float glass.

B. Fabricator: Certified by glass manufacturer, IGCC, and SGCC for type of glass, coating, treatment, and assembly involved and capable of providing specified warranty.

C. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers: Continuous run / bend, warm-edge technology design.
      a. Spacer Width: As required for specified insulating glass unit.
      b. Spacer Height: Manufacturer's standard.
   4. Spacer Color: Black.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone or polysulfide sealant as secondary seal applied around perimeter.
      b. Color: Black.
   6. Purge interpane space with dry air, hermetically sealed.

D. Type IGU-1 - Insulating Glass Units: Tinted vision glass, double glazed. with low-e coating.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Total Thickness: 1 inch.
   3. Space between lites filled with argon.
   4. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.24, maximum.
   5. Visible Light Transmittance (VLT): 34 percent, nominal.
   6. Solar Heat Gain Coefficient (SHGC): 0.25, maximum.
   7. Basis of Design: Vitro Architectural Glass, Pacifica Glass with Solarban 60 (3) Clear.
      a. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
         1) Coating: Uncoated.
         2) Color: Deep blue.
      b. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
         1) Coating: Low-E. Solarban 60 on #3 surface.
         2) Color: Clear.

E. Type IGU-2 - Insulating Glass Units: Spandrel glazing.
   1. Applications: Exterior spandrel glazing unless otherwise indicated.
   2. Total Thickness: 1 inch.
   3. Space between lites filled with argon.
   4. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.24, maximum.
   5. Visible Light Transmittance (VLT): 0 percent.
   6. Solar Heat Gain Coefficient (SHGC): 0.25, maximum.
   7. Basis of Design: Vitro Architectural Glass, Solexia Glass with Solarban R100 (2).
      a. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
         1) Coating: Solarban R100 on #2 surface.
         2) Color: Light green.
      b. Inboard Lite: Fully tempered float glass, 1/4 inch thick.
         1) Coating: Ceramic Frit on #4 surface.
         2) Color: Ford Blue SX10774.

F. Type IGU-3 – Insulated Glass Units: Frosted glazing.
   1. Applications: Exterior frosted glazing at doors 113, 119, 121 and 168.
   2. Total Thickness: 1 inch.
   3. Space between lites filled with argon.
   4. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.24, maximum
   5. Visible Light Transmittance (VLT): 34 percent, nominal.
   6. Solar Heat Gain Coefficient (SHGC): 0.25, maximum.
   7. Basis of Design: Vitro Architectural Glass, Pacifica Glass with frosted glass (3) Clear.
      a. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
         1) Coating: Uncoated.
         2) Color: Deep blue.
      b. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
         1) Coating: Uncoated.
         2) Surface Treatment: Frosted on #3 surface. Frosted treatment to be etch or sandblasted. Frosted window films are not permissible.
         3) Color: Clear.

2.6 GLAZING UNITS

A. Type G-1 - Monolithic Safety Glazing: Non-fire-rated.
   1. Applications:
      a. Glazed lites in interior doors.
      b. Interior sliding and folding glazed walls and doors.
      c. Other locations required by applicable federal, state, and local codes and regulations.
      d. Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered safety glass as specified.
   3. Tint: Clear.

4. Thickness: 1/4 inch, nominal.

B. Type G-2 - Laminated Glazing: Laminated glass, 2-Ply.
1. Applications: Glazing lites in interior aluminum framed storefront systems at rooms 103 and 118. Glazing lites in doors 166, 169C and 170C.
2. Tint: Clear.
3. Thickness: 9/16 inch, minimum.
4. Outer Lite: 1/4 inch Annealed glass.
5. Interlayer: Polyvinyl butyral (PVB), thickness as required to meet performance criteria, 0.060 inch thick, minimum.
6. Inside Lite: 1/4 inch Annealed glass.
7. Sound Transmission Class Rating: STC 39 rating.

2.7 GLAZING COMPOUNDS

A. Type GC-1 - Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; black color.

B. Type GC-2 - Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

C. Type GC-3 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.8 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Silicone, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry immediately before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

E. Install gaskets without joints, except at corners.
   1. Do not stretch gaskets; cut gaskets long and allow gaskets to relax, then trim to length.

F. Seal gasket corners.

G. Install pressure plates without displacing glazing gasket; exert pressure for full continuous contact to produce a weathertight seal without developing bending stresses in glass or over-compressing gaskets.
   1. Install pressure caps by hand tool tightening.
   2. Install pressure plates as recommended by curtainwall manufacturer; including fastener spacing and fastener torque.
   3. Verify torque on fasteners installed in the pressure plate are as required. Contractor to sample 100% of fasteners installed each day utilizing a calibrated torque wrench. Submit verification log using a form similar to the table shown below:

Curtainwall Pressure Plate Fastener Torque Log				
Project Name:				
Date	Tester's Initials	Location	Manufacturer's Torque Requirement	Torque Pass/Fail

3.5 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.6 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.7 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 08 87 23 - SAFETY AND SECURITY FILMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Decorative Window Film

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets for specified product

B. Shop Drawing showing location and layout

C. Samples: For each film product to be used, minimum size 4 inches by 6 inches, representing actual product, color, and patterns.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project
   1. (1) full glass panel size of extra material at time of installation. Deliver in protective packaging for storage and label contents appropriately.

E. Specimen Warranty.

1.3 MOCK-UP

A. Provide mock-up where indicated on drawings for Owner and Architect review.
   1. Provide (1) full glazing panel
   2. Mock-up may remain in place if accepted
   3. Do not proceed with installation until mock-up has been approved

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of glazing films with minimum 10 years successful experience.

B. Installer Qualifications: Installation shall be performed by a trained and qualified installer, specializing and experienced in work required for this project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation with identification labels intact.

B. Deliver, store and handle products in accordance with manufacturers recommendations.

C. Store products protected from weather, temperature and other harmful conditions as recommended by manufacturer.

1.6 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Confirm appropriate substrate for mounting of glass finish components prior to start of installation.

C. Environmental Limitations: do not install until spaces are enclosed and weatherproof, wet work in space is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.

1.7 WARRANTY

A. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: As indicated on drawings, OR equal as determined by Owner and Architect

B. Glazing Film: translucent, embossed vinyl film with clear pressure-sensitive adhesive
   1. Pattern & Color: As indicated on drawings
   2. Thickness: 7mil
   3. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed Index of 450, Maximum, when tested in accordance with ASTM E84 (Class A).

C. Accessory Materials: As recommended or required by film manufacturer.

D. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.

B. Verify glass is not cracked, chipped, broken, or damaged.

C. Verify that frames are securely anchored and free of defects.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Do not proceed with installation until unsatisfactory conditions have been corrected. Proceeding with installation implies acceptance of substrate and conditions.

3.2 PREPARATION

A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.

B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.

C. Protect adjacent surfaces.

D. Do not begin installation until substrates have been properly prepared.

E. comply with all manufacturers instructions for surface preparation.

3.3 INSTALLATION

A. Verify mock-up has been approved prior to material acquisition.

B. Do not apply glazing film when surface temperature is less that 40 degrees F or if precipitation is imminent.

C. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.

D. Accurately cut film with straight edges to required sizes allowing 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required by anchorage method.

E. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.

F. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.

G. Remove labels and protective covers.

3.4 PROTECTION & CLEANING

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

C. Use cleaning methods recommended by manufacturer.

END OF SECTION

SECTION 09 05 61 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile.
   2. Carpet tile.
   3. Porcelain tile.

B. Preparation of new concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Patching compound.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.3 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

B. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Recommendations for remediation of unsatisfactory surfaces.
   5. Submit report to Architect.
   6. Submit report not more than two business days after conclusion of testing.

1.4 QUALITY ASSURANCE

A. Contractor may perform moisture and alkalinity (pH) testing with Contractor's own personnel or hire an independent testing agency employed and paid by Contractor.
   1. In either case, the testing technician must meet the qualifications below.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Testing include but are not limited to:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.

5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

D. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.

E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

1.6 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 96 prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 96 prior to testing, at not less than 40 percent and not more than 60 percent.

C. If the permanent HVAC system is not operable provide temporary heating, cooling, or dehumidification equipment as required to maintain the specified environmental conditions.

D. The building envelope thermal, air, and vapor barriers are all required to be fully enclosed for at least two-weeks prior to testing.

PART 2 PRODUCTS

2.1 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product containing the characteristics listed below, suitable for conditions, and compatible with remedial floor coatings, adhesive and floor covering.
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
   3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
   4. Self-leveling and trowel applied products are acceptable.
   5. Products:
      a. ARDEX Engineered Cements; ARDEX Feather Finish: www.ardexamericas.com/#sle.
      b. H.B. Fuller Construction Products, Inc; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle.
      c. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: www.usg.com/#sle.

PART 3 EXECUTION

3.1 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
   3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Patching, smoothing, and leveling, as required.
   6. Other preparation specified.
   7. Protection.

3.2 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.3 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

3.4 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.5 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
   1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
   2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
   3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

D. Report: Report the information required by the test method.

3.6 PREPARATION

A. See individual floor covering section(s) for additional requirements, including floor leveling tolerance.

B. Comply with recommendations of testing agency.

C. Comply with requirements and recommendations of floor covering manufacturer.

D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

E. Do not fill expansion joints, isolation joints, or other moving joints.

3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.8 PROTECTION

A. Cover prepared floors with durable, non-marring, covering.

B. See individual floor covering section(s) for additional requirements, including stripping and waxing where required.

END OF SECTION

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum sheathing.

F. Cementitious backing board.

G. Gypsum wallboard.

H. Joint treatment and accessories.

I. Acoustic (sound-dampening) wall and ceiling board.

1.2 RELATED REQUIREMENTS

A. Section 05 40 00 - Cold-Formed Metal Framing: Structural steel stud framing.

B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

C. Section 09 30 00 - Tiling: Tile backing board.

1.3 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.

J. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

K. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

L. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

M. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

N. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

O. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018 (Reapproved 2023).

P. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

Q. ASTM C1629/1629M – Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.

R. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).

S. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

U. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

V. ASTM E413 - Classification for Rating Sound Insulation; 2022.

W. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

X. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.

1.4 SUBMITTALS

A. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.
   1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

B. Steel Framing Industry Association (SFIA) Certification:
   1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.

1.5 QUALITY ASSURANCE

A. SFIA Code Compliance Certification Program: www.CFSteel.org/#sle: Use metal studs and connectors certified for compliance with International Building Code.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions Indicated as Sound-Rated: Provide completed assemblies with the following characteristics:
   1. STC indicated on the Wall Type Schedule on the Drawings, calculated in accordance with ASTM E413 based on tests conducted in accordance with ASTM E90
   2. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90 and per test assembly as indicated on Drawings.

C. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
   1. ICC-ES Evaluation Report No. for an interior grid suspension system and ESR-4358..

2.2 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Cold-Formed Metal Framing for use in Gypsum Board Assemblies: See Section 05 40 00.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. At wall brittle wall finishes such as tile or stone cladding maximum deflection of wall framing is limited to L/360 at 5 psf.
   2. Studs: C-shaped with knurled or embossed faces.
   3. Runners: U shaped, sized to match studs.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
   5. Minimum stud gauge as indicated on the Wall Type Schedule on the Drawings. Use heavier gauge if required to meet the performance requirements of this Section.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
   3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems of fire rating and movement required.
   4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
      a. Products:
         1) ClarkDietrich; MaxTrak.
         2) Metal-Lite, Inc; The System.

E. Non-structural Framing Accessories:
   1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
      a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
      b. Products:
         1) ClarkDietrich; Pony Wall (PW).
   2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
   3. Flexible Wood Backing: Fire-retardant-treated wood with sheet steel connectors.
      a. Products:
         1) ClarkDietrich; Danback.

F. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Products:
      a. CertainTeed Corporation; Drywall Suspension System.
      b. USG Corporation; Drywall Suspension System.
      c. Chicago Metallic; Drywall Grid.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. Basis of Design: Gold Bond Building Products, LLC provided by National Gypsum Company.
   2. CertainTeed Corporation.
   3. Georgia-Pacific Gypsum.
   4. USG Corporation.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold resistant board is required at all locations.
   4. Thickness: As indicated on Drawings.
   5. Long Edges: Tapered.
   6. At STC Assemblies Indicated with Fire-Resist gypsum core: Use type required by indicated STC tested assembly on Drawings.
      a. Products:
         1) Basis of Design: Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Fire-Shield Gypsum Board.

C. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings, unless otherwise indicated.
   2. Thickness: As indicated on Drawings.
   3. Edges: Tapered.

D. Impact Resistant Wallboard:
   1. Application: Where indicated on the Wall Type Schedule on the Drawings.
   2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   5. Hard Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   7. Type: Fire-resistance-rated Type X, UL or WH listed.
   8. Long Edges: Tapered

E. Acoustical Sound Dampening Wall and Ceiling Board: Two layers of heavy paper-faced, high-density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of 50 or more in typical stud wall assemblies as calculated in accordance with ASTM E413 and when tested in accordance with ASTM E90.
   1. Thickness: As indicated on Drawings.
   2. Long Edges: Tapered.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   4. Products:
      a. Basis of Design: Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond SoundBreak XP Wall Board.

F. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
   4. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
   5. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   6. Core Type: Type X.
   7. Type X Thickness: 5/8 inch or as indicated on Drawings.
   8. Edges: Square.

2.4 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: Preformed glass fiber or mineral wool, friction fit type, unfaced. Thickness as required to fill the full depth of the stud cavity. Insulation type per test assembly as indicated on Drawings.

B. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
   1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   2. Tape Thickness: 1/4 inch.

C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
   1. Products:
      a. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant.
      b. Liquid Nails, a brand of PPG Architectural Coatings.
      c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant.

D. Water-Resistive Barrier: Refer to Division 07, Section Air / Vapor Barriers.

E. Finishing Accessories
   1. U-shape reveal molding, refer to drawings for locations
      a. Manufacturer: Fry Reglet, or equal as determined by Owner and Architect
      b. Product: appropriate for adjacent materials and reveal size, as indicated on drawings
      c. Material: aluminum
      d. Finish: powder coat
      e. Color: as indicated on drawings
   2. L-shaped Architectural Trims, refer to drawings for locations
      a. Manufacturer: Wolf Gordon or equal as determined by Owner and Architect
      b. Product: Bend Trim
      c. Material: Aluminum
      d. Finish: Mill Finish
      e. Size: 1.5 inches

F. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic or galvanized steel, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
   2. L-Trim with Tear-Away Strip: Sized to fit 5/8 inch thick gypsum wallboard.
   3. Wall Mounted Deflection Beads: Flexible gasket and bead with 1-1/8 inch flange.
   4. Expansion Joints:
      a. Type: V-shaped PVC with tear away fins.

G. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Self-Adhered Flashing Tape: 4 inch wide minimum, industrial tape with pressure-activated acrylic adhesive.
      a. Manufacturer: Zip System.
   2. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   3. Paper Tape: 2 inch wide, creased paper tape for joints and cornersmay be substituted for fiberglass tape at interior locations only.
   4. Joint Compound: Drying type, vinyl-based, field-mixed. For use with paper tape.
   5. Joint Compound: Setting type, field-mixed. For use with fiberglass tape.

H. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

I. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

J. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

B. Start of Work indicates acceptance of conditions.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center.
1. Level ceiling system to a tolerance of 1/1200.
2. Laterally brace entire suspension system.
3. Install bracing as required at exterior locations to resist wind uplift.

C. Studs: Space studs as indicated on Drawings or at 16 inches on center minimum, whichever is more stringent.
1. Extend partition framing to structure in all locations.
2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Blocking: Install wood blocking for support of:
1. Framed openings.
2. Wall-mounted cabinets.
3. Plumbing fixtures.
4. Toilet partitions.
5. Toilet accessories.
6. Wall-mounted door hardware.
7. Hand rails and grab bars.
8. Wall protection bumper rails.
9. Art Work.
10. Wall mounted window treatments.
11. Other locations where indicated in Division 6 Section 'Rough Carpentry'.
12. Other locations where indicated on the Drawings.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.

C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.

D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

3.6 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish, spaces with exterior curtainwall or interior storefront glazing, and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish, plaster finish or wall coverings, unless otherwise indicated.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

E. Where a Level 5 finish is required skim coat entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.7 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.8 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

SECTION 09 25 23 - LIME BASED PLASTERING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Venetian plaster

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for systems specified, demonstrating compliance with requirements.

B. Samples:
   1. Plaster Finish: Submit at least three 16 inch by 16 inch min sample boards varied across the pigment range demonstrating color, texture and application movement for each required plaster finish.
      a. to be reviewed in the actual room, under actual lighting conditions.
      b. Final sample to require written sign-off from designer prior to production.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Plasterer Qualifications: Company specializing in Venetian Plaster with minimum five years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original and unopened packaging, with brand names and manufacturer's labels intact and legible.

B. Store materials in dry location, fully protected from weather.

1.5 FIELD CONDITIONS

A. Cold-Weather Requirements:
   1. Do not apply plaster when surface or ambient temperature is less than 41 degrees F or above 93 degrees F

PART 2 - PRODUCTS

2.1 MATERIALS

A. Venetian Lime Plaster, natural mineral-based, fine grade, smooth finish, applied with trowel
   1. Manufacturer: Color Atelier
   2. Type: Lime Plaster
   3. Color: As indicated on drawings
   4. Coats: 3-coat system, scratch-body-top
   5. Finish: Suede
   6. Top Coat: Sealer

7. Application: Cross-hatch pattern with long & sweeping strokes.

B. Primer
1. Mineral Smooth Primer, As recommended by manufacturer

C. Sealer
1. As recommended by manufacturer
2. Clear 100% acrylic, clear protective topcoat. non-toxic water based. non-yellowing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area verify the surface is clean and cohesive; repair dents, holes, and imperfections.

B. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of plaster manufacturer.

C. Verify environmental field conditions have been met.

3.2 PREPARATION

A. Substrate to be primed gyp board with level 4 finish.

B. Protection: Protect adjacent surfaces from soiling and damage.

C. Prepare surfaces in accordance with manufacturers requirements and recommendations.

D. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

E. Surfaces: Correct defects and clean surfaces that affect work of this section.

3.3 PLASTER APPLICATION

A. General:
1. Comply with lime manufacturer's instructions.
2. Mix the product thoroughly before use to ensure consistency.
3. Apply Lime Plaster in three coats, in successive thin layers with a trowel, coating knife or spatula as evenly as possible avoiding lines and ridges.
4. Apply the second coat only after the first coat is completely dry.
5. Allow to dry 24 hours between coats.
6. Apply Sealer after allowing a minimum of 48 hours to dry.
7. Install coats as follows:
   a. First or Scratch Coat: 3/8-inch nominal thickness.
   b. Second, Strengthening, or Brown Coat: 3/8-inch nominal thickness.
   c. Top or Finish Coat: One layer of 1/8-inch nominal thickness.
      1) Surface Texture: As indicated on drawings; PCA EB049.

3.4 JOINTING

A. Do not bridge expansion or control joints.

3.5 CLEANING

A. Remove and discard temporary protection after plaster work in each area has been completed. Remove plaster from other exposed surfaces, leaving them in undamaged condition; dispose of packaging materials and plaster debris.

3.6 PROTECTION

A. Do not permit construction activities at or near finished plaster wall.

END OF SECTION

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Ceramic accessories.

D. Non-ceramic trim.

E. Porcelain wall cladding

1.2 RELATED REQUIREMENTS

A. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.3 SUBMITTALS

A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

C. Samples: Provide one sample of each tile, 12"x12"min. Provide 3 inch long actual sample of each grout.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Tile: 10 square feet of each size, color, and surface finish combination. Extra tiles shall be from same production runs as products installed and that are packages with protective coverings for storage and identified with labels describing contents.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, storage and handling in accordance with manufacturer's instructions.

B. Comply with requirements in ANSI A137.1 for labeling tile packages.

C. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

D. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surface of tile, remove coating from bonding surfaces before setting tile.

1.5 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Follow manufacturer's Recommended procedures for producing best results, including testing of substrates, moisture in substrates and humidity & temperature limitations.

C. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

D. Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in manufacturer’s written instructions.

PART 2 PRODUCTS

2.1 TILE

A. Tile: All products of each type indicated in drawings by same manufacturer to be by the same manufacturer.
   1. Manufacturer: As indicated on Drawings OR approved equal as determined by Owner and Architect.
   2. Tile: Style, Color, Size, Finish and Installation as indicated on Drawings OR approved equal as determined by Owner and Architect.

2.2 PORCELAIN LARGE FORMAT WALL CLADDING

A. Porcelain Slab Wall Panels: Gauged porcelain slabs over continuous substrate.
   1. Gauged Porcelain Slab: ANSI A137.3standard grade.
   2. Manufacturers: As Indicated on drawings, no substitutions
   3. Size: As indicated on drawings
   4. Thickness: 6mm
   5. Surface Finish: Glossy
   6. Color: As indicated on drawings
   7. Large and Heavy Tile (LHT) Mortar

2.3 TRIM AND ACCESSORIES

A. Base: As indicated on drawings

B. Non-Ceramic Trim: As indicated on drawings.
   1. Applications:
      a. Transition between floor finishes of different heights
      b. Cove transition between wall tile and floor tile.
      c. Outside vertical corner trim at tile walls.
   2. Manufacturers:
      a. Schluter-Systems: www.schluter.com. as indicated on drawing.
      b. or equal, as determined by Owner and Architect.

2.4 SURFACE PREPARATION PRODUCTS

A. Refer to specification section 09 05 61 Common Work Results for Flooring Preparation for additional requirments.

B. Provide cement based self-leveling underlayment to remedy any depressions in existing floor to allow for plumb/flat installation meeting the minimum mortar coverage requirements and TCNA flatness guidelines.

It is understood that the substrate may not be in tolerance for large unit tile, and prep will be under the scope of the tile installation package.

C. Patching Compound: Floor covering manufacturer's recommended product containing the characteristics listed below, suitable for conditions, and compatible with remedial floor coatings, adhesive and floor coverings.
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing ad edges.
   2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
   3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
   4. Self-leveling and trowel applied products are acceptable.
   5. Products:
      a. ARDEX Engineered Cements; ARDEX Feather Finish: www.ardexamericas.com/#sle.
      b. H.B. Fuller Construction Products, Inc; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle.
      c. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: www.usg.com/#sle

2.5 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
   1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
   2. Products:
      a. Mapei, Ultralite S2; https://www.mapei.com
      b. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.
      c. H.B. Fuller Construction Products, Inc; TEC Ultimate Large Tile Mortar: www.tecspecialty.com/#sle.
      d. LATICRETE International, Inc; 257 TITANIUM: www.laticrete.com/#sle.

C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.

D. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.

2.6 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Grout: All products of each type by the same manufacturer.
   1. Manufacturer: As indicated on Drawings OR approved equal as determined by Owner and Architect.
   2. Grout: Style, Color, Size, Finish and Installation as indicated on Drawings OR approved equal as determined by Owner and Architect.

2.7 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
   1. Applications:
      a. Soft joints in tile.
      b. Between tile and plumbing fixtures.
      c. floor/wall intersections
      d. intersection of tiled walls.
   2. Color(s): Match grout color.
   3. Products:

a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
b. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.
c. Merkrete, by Parex USA, Inc; Merkrete Colored Caulking: www.merkrete.com/#sle.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.

2.8 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Crack Resistance: No failure at 1/8 inch gap, minimum.
2. Fluid or Trowel Applied Type:
a. Material: Synthetic rubber or Acrylic.
b. Thickness: 25 miles, minimum, dry film thickness.
c. Products:
1) H.B. Fuller Construction Products, Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane.
2) LATICRETE International, Inc; LATICRETE Blue 92 Anti-Fracture Membrane.
3) Sika Corp; SikaTile 200 Fracture Guard Rapid.

B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
2. Fluid or Trowel Applied Type:
a. Material: Synthetic rubber or Acrylic.
b. Thickness: 25 mils, minimum, dry film thickness.
c. Products:
1) H.B. Fuller Construction Products, Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane.
2) LATICRETE International, Inc; LATICRETE HYDRO BAN.
3) Sika Corp; SikaTile 100 Moisture Guard.

C. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

D. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Verify that required floor-mounted utilities are in correct location.

E. Maximum variation from the required plane (as specified by the Tile Council of America)

1. Tiles with no edges greater than 15 inches, floors and walls: ¼ inch in 10 feet and/or 1/16 inch in 1 foot.
2. Tiles with at least one edge greater than 15 inches, floors and walls: 1/8 inch in 10 feet, and/or 1/16 inch in 2 feet.

F. Notify Architect and General Contractor in writing of unsatisfactory conditions.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19 , manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install ceramic accessories rigidly in prepared openings.

G. Install non-ceramic trim in accordance with manufacturer's instructions.

H. Install thresholds where indicated.

I. Sound tile after setting. Replace hollow sounding units.

J. Keep control and expansion joints free of mortar, grout, and adhesive.

K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

L. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
   1. Install crack isolation membrane in accordance with manufacturer requirements.
   2. Install waterproofing membrane at Catering Kitchen and at all Toilet Rooms, in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.

B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.5 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244.

3.6 CLEANING

A. Clean tile and grout surfaces.

3.7 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation and in accordance with tile manufacturers instructions.

END OF SECTION

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.3 SUBMITTALS

A. Shop Drawings: Indicate grid layout and related dimensioning.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer to ensure fit and function.

B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.5 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. As noted on drawings.
   2. Substitutions not permitted.

B. Suspension Systems:
   1. Same as for acoustical units.

2.2 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

2.3 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
   1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; As indicated on drawings inch face width.
   3. Finish: Baked enamel.
   4. Color: As indicated on drawings

2.4 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Perimeter Moldings: Same metal and finish as grid.
   1. Size: As required for installation conditions.
   2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
   3. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.

E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

C. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

C. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

D. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
   1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap corners.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

J. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

K. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

3.4 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Lay directional patterned units with pattern parallel to longest room axis.

D. Fit border trim neatly against abutting surfaces.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.
   2. Double cut and field paint exposed reveal edges to match face color.

G. Where round obstructions occur, provide preformed closures to match perimeter molding.

H. Install hold-down clips on panels within 20 ft of an exterior door.

I. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

J. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.5 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.6 CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION

SECTION 09 54 23 - LINEAR METAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Linear metal ceilings.

B. Suspended metal support system and perimeter trim.

1.2 DESIGN REQUIREMENTS

A. Design components to ensure light fixtures and installed accessories will not induce eccentric loads. Where components may induce rotation of ceiling system components, provide stabilizing reinforcement.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate work of this section with installation of mechanical and electrical components and with other construction activities affected by work of this section.

B. Preinstallation Meeting: Convene one week before starting work of this section.

1.4 SUBMITTALS

A. Product Data: Furnish for component profiles, materials, and perimeter and integral trim of each type of metal ceiling unit.

B. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with or supported by the ceilings.

C. Samples: Submit two samples full width by 12 inch in size illustrating profile, color and finish of exposed to view components.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project. Packaged with protective coverings for storage and identified with appropriate labels.
   1. Acoustical Metal Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
   2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept factory-finished products on site in manufacturer's unopened factory packaging only; reject opened packages.

B. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

C. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

D. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.7 WARRANTY

A. Planks: Submit a written One year, from substantial completion, warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
   1. Planks: Sagging and warping
   2. Grid System: Rusting and manufacturer's defects.

B. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Linear Metal Ceilings:
   1. Armstrong World Industries, Inc; Metal Works: www.armstrongceilings.com/#sle.
   2. Substitutions: 01 25 13 Product Substitutions Procedures, as determined by Owner and Architect.

2.2 LINEAR METAL CEILINGS

A. Linear Metal Ceiling System: Panels, suspension members, trim, and accessories as required to provide a complete system.

B. Linear Metal Plank Ceiling System, Acoustic, Interior, Type PCS1a:
   1. Product: Armstrong MetalWorks Linear-Classics, Planks 5493 - 8" Microperforated with plain border, acoustical fleece and added fiberglass infill panel
   2. Surface Texture: Smooth
   3. Composition: Electrogalvanized Steel 0.028 inch
   4. Color: Effects Cherry FXCH
   5. Size: 8 inch x 96 inch
   6. Edge Profile: Linear
   7. Perforation: Perforated, M2

8. Noise Reduction Coefficient (NRC): 0.85, measured in accordance with ASTM C423 with insulation installed.
9. Acoustic Backer: Acoustic Fiberglass Infill Panel, 8200T10
10. reveal strips: Contrast Filler Strips
11. Design to support imposed loads of indicated items without eccentric loading of supports.
12. Design for maximum deflection of 1/360 of span.
13. Surface Burning Characteristics: ASTM E 84 and complying with ASTM E 1264 Classification.

C. Linear Metal Plank Ceiling System, Exterior, Type PCS1b:
1. Product: Armstrong MetalWorks Linear-Classics, Planks 5491 - 8" Unperforated.
2. Surface Texture: Smooth
3. Composition: Electrogalvanized Steel 0.028 inch
4. Color: Effects Cherry FXCH2
5. Size: 8 inch x 96 inch
6. Edge Profile: Linear
7. Perforation: Unperforated, M1
8. reveal strips: Contrast Filler Strips
9. Design to support imposed loads of indicated items without eccentric loading of supports.
10. Design for maximum deflection of 1/360 of span.
11. Surface Burning Characteristics: ASTM E 84 and complying with ASTM E 1264 Classification.
12. Systems Located Outside Building Envelope:
    a. Accommodate wind and suction loads and wind uplift without damage in accordance with applicable code and structural drawings, whichever is greater.

2.3 COMPONENTS

A. Acoustical Backer: Manufacturer's standard fiberglass; as required to achieve specified acoustic performance.

B. Edge Molding, Expansion Joints, and Splices: Same material, thickness, and finish as linear panels.

C. End Caps: Formed metal; same color and finish as sight-exposed surfaces of linear panels.

D. Accessories: Stabilizer bars as required for suspended grid system; sight-exposed surfaces same color and finish as sight-exposed surfaces of linear panels.

E. Suspension Members: Formed steel sections, with integral attachment points; galvanized finish; size and type to suit application and ceiling system flatness requirement specified.

F. Suspension Wire: Steel, annealed, galvanized finish, 9 gauge, 0.1144 inch diameter.

G. Suspension Wire: Size and type as required for application and ceiling system flatness requirement specified.

H. Subgirt Members: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating; formed to resist imposed loads and to provide attachment for linear ceiling and accessories.

I. Subgirt Members: Prime painted steel sheet, formed to resist imposed loads and to provide attachment for linear ceiling and accessories.

J. Filler strips: Contrast Filler Strips 5494

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Verify that field measurements are as indicated.

E. Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

F. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Suspension Components:
   1. Install after above-ceiling work is complete in accordance with manufacturer's instructions, ASTM C636/C636M, and ASTM E580/E580M.
   2. Hang carrying members independent of walls, columns, ducts, light fixtures, pipe, and conduit; where carrying members are spliced, avoid visible displacement of face panels with adjacent panels.
   3. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest adjacent hangers to span the required distance.
   4. Locate suspension system for linear panel layout on room axis according to reflected plan.

B. Linear Metal Ceiling:
   1. Install linear panels, baffles, and other system components in accordance with manufacturer's instructions.
   2. Stagger end joints minimum 12 inches.
   3. Align end joints.
   4. Butt interior end joints tight.
   5. Set exterior end joints with 1/16 inch gap for expansion and contraction.
   6. Provide expansion joints to accommodate plus or minus 1 inch movement and maintain visual closure.
   7. Install filler strips between linear panels at interior and exterior locations.
   8. Install edge moldings at junctions with other finishes and at vertical surfaces; use maximum piece lengths.
   9. Install end caps at sight-exposed ends of linear panels.
   10. Exercise care when site cutting sight-exposed finished components to ensure surface finish is not defaced.

C. Insulation: Install above panel members; fit tight between grid members .

3.4 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

C. Maximum Variation From Dimensioned Position: 1/4 inch.

3.5 ADJUSTING AND CLEANING

A. Replace damaged, abraded and broken planks and components.

B. B. Clean exposed surfaces of ceilings planks, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient tile flooring.

B. Installation accessories.

1.2 RELATED REQUIREMENTS

A. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.3 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Shop Drawings: Indicate seaming plans and floor patterns.

C. Closeout Submittals:
   1. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
   2. Warranty: Manufacturer's product warranty and an installer's labor/workmanship warranty

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store materials in a clean, dry, enclosed space off the floor, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation

C. Do not double stack pallets.

PART 2 PRODUCTS

2.1 TILE FLOORING

A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
   1. Manufacturers:
      a. Basis of Design: AHF Products, Armstrong Flooring, Inc; Standard Execelon Imperial Texture: www.armstrongflooring.com/#sle.
      b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle.
   2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   4. Size: 12 by 12 inch.
   5. Thickness: 0.125 inch.
   6. Pattern: Monolithic.
   7. Color: As indicated on drawings.

2.2 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 05 61.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.2 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

3.3 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

3.4 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.

D. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.

3.5 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.6 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient base.

B. Resilient reducer strip

1.2 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Wall Base: Quantity equivalent to 10 percent of each type and color.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, storage and handling in accordance with manufacturer's instructions.

B. Check materials for damage and the correct style, color, quantity and run numbers.

C. Store all materials off of the floor in an acclimatized, weather-tight space with ambient temperatures maintained within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

D. Do not double stack pallets.

1.5 PROJECT CONDITIONS

A. Install resilient products after other finishing operations, including painting, have been completed.

   Maintain ambient temperatures within range recommended by Manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 deg C) in spaces to receive resilient products 48 hours before installation, durring installation and 48 hours after installation.

B. Maintain the ambient relative humidity between 40% and 60% during installation.

C. Until Substantial Completion, maintain ambient temperatures within range recommended by Manufacturer, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

PART 2 PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base Type TS: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
   1. Performance requirements meets ASTM F1861 Standard Specification for Resilient Thermoplastic Rubber Wall Base, Type TS, Group 1.
   2. Manufaturer: As indicated on drawings.
   3. Profile: As indicated on drawings.
   4. Height: As indicated on drawings.
   5. Thickness: 0.125 inch.
   6. Pre-formed corners.
   7. Color: As indicated on drawings.

2.2 RESILIENT REDUCER STRIP

A. Rubber Reducer Strip
   1. Performance requirements meets ASTME84 Surface Burning, ASTM E648 (NFPA 253) Critical Radiant Flux Class I, passes ASTM E662 (NFPA 258) Smoke Desnity
   2. Features: PVC Free, ADA compliant, non-pourous
   3. Manufaturer: As indicated on drawings.
   4. Profile: As indicated on drawings.
   5. Size: As indicated on drawings.
   6. Color: As indicated on drawings.

2.3 ADHESIVES

A. As recommended for best result by manufacturer to meet site conditions
   1. Tarkett 960 Cove Base Adhesive for Porous applications, or Equal
   2. Tarkett 946 Premium Contact Bond Adhesive for Non-porous applications, or Equal

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not install tile until construction in space is complete and ambient temperature and humidity conditions are maintained at the levels indicated in manufacturers written instructions.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, dust-free, clean, permanently dry, structurally sound and are ready to receive resilient base.

C. substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Ensure substrate meets the requirements of ASTM F710 and prepare substrates according to Manufacturuers' written instructions to ensure adhesion of resilient wall base.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate. Substrates must be free of visible water or moisture, dust, sealers, paint, sweeping compounds, curing compounds, residual adhesives and adhesive removers, concrete hardeners or densifiers, solvents, wax, oil, grease, asphalt, visible alkaline salts or excessive efflorescence, mold, mildew and any other extraneous coating, film, material or foreign matter.

C. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Install baseon solid backing. Tightly adhere resilient wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. If caulking or sealing is required after installation, please contact the manufacturer for a suitable, matching caulk.

3.4 CLEANING AND PROTECTION

A. Comply with Manufacturers written instructions for cleaning and protection of resilient products

B. Immediately after completing resilient product installation remove adhesive and other blemishes from exposed surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION

SECTION 09 68 13 - TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.2 RELATED REQUIREMENTS

A. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures, cleaning and preparation.

1.3 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Shop Drawings: Indicate, layout of joints, pattern direction and layout, edge trim locations and types

C. Samples: Submit carpet tile illustrating color and pattern design for each carpet color selected.

D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing commercial carpet tile with minimum three years documented experience and approved by carpet tile manufacturer. It is required, that the firm or individual shall be a member of the Floor Covering Contractors Association (FCICA) and/or certified by the Certified Floorcovering Installers Association (CFI).

B. Flooring contractor to provide owner a written warranty that guarantees the completed installation to be free from defects in material and workmanship for a period of no less than two (2) years after job completion.

C. All warranties must be issued by the manufacturer as standard published warranties on all types of flooring modules within this document. Second source warranties that involve parties other than the carpet manufacturer are unacceptable. If the product fails to perform as warranted when installed according to manufacturer's installation instruction and maintain accordingly to Manufacturer's maintenance Instructions, the affected area will be repaired or replaced at the expense of the manufacturer. Provide standard published written performance warranties to the Owner for the following:
   1. Carpet Tile:
      a. Lifetime warranty against excessive surface wear. Excessive wear means no more than 10% loss of pile fiber weight measured before adn after use as tested under ASTM D-3936.
      b. Lifetime static propensity, meaning built-in protection below 3.0 kv as tested under AATCC-134.

c. Tuft Bind (edge ravel, yarn pulls, zippering)
d. Delamination
e. Lifetime Moisture Barrier
f. Lifetime Dimensional Stability

D. Flooring material to meet or exceed the following test performance criteria as tested by a recognized independent testing laboratory. Requirements listed below must be met by all products being submitted for approval:
1. Pill Test / DOC-FF-1-70 (ASTM D-2589) - Requirement: Pass
2. Flooring Radiant Panel / ASTM E-648 - Requirement: Class I (Above .45 w/cm)
3. CRI VOC Green Label Plus Test (CRI-GLP).

1.5 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

B. Deliver all materials to the installation site in the manufacturer's original packaging and in good condition. Packaging to contain manufacturer's name and marks, identification number, shipping and handling instructions and related information. Delivered and stored materials must be available for inspection as required by the owner, architect, general contractor and/or the manufacturer.

C. Sub-floor preparation is to include all required work to prepare the existing floor for installation of ht e product as specified in this document. Sub-floor preparation shall meet all conditions as specified in Manufacturers' carpet tile installation instructions.

D. All materials, including adhesives, are to be delivered to the site of installation at a minimum of 48 hours prior to the start of installation and stored in a clean and dry room that measures above 65°F and below 95°F and measures between 10% and 65% relative humidity (RH). To maintain temperature and relative humidity, permanent heating and air conditioning systems (HVAC) must be in operation. Place pallets of carpet tiles on a flat surface (do not double stack pallets). After work is complete, the ambient room temperature should remain at 65°F and relative humidity between 10%-65% for 48 hours. These materials and related adhesives shall be protected from the direct flow of heat from heating fixtures and appliances such as hot-air registers, radiators or other. Site conditions shall include those specified in the flooring manufacturer's installation instructions and shall also include sufficient heat, light adn power required for effective and efficient working conditions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tile Carpeting:
1. See Finish Legend on interiors drawings for manufacturer, product, style, color, size, etc

2.2 MATERIALS

A. Tile Carpeting: Solution dyed, manufactured in one color dye lot.
1. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
2. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
3. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.

2.3 ACCESSORIES

A. Subfloor Filler: type recommended by flooring material manufacturer.

B. Flooring Primer (Gypcrete):
   1. Manufacturer Basis of Design: type recommended by flooring material manufacturer.

C. Edge Strips: As indicated on Finish Material Legend.

D. Adhesives: As recommended by carpet tile manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 05 61.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

F. Inspect prior to installation for proper style, Color and potential defects. Should there be a problem, contact the flooring Manufacturer.

G. Carpet installation shall not commence until painting and finishing work is complete and ceiling and overhead work is tested, approved and complete.

3.2 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with portland cement-based patch reinforced with polymers.

C. Apply, trowel, and float portland cement-based filler to achieve smooth, level, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate removing dust, dirt and debris.

E. Concrete moisture testing and pH Testing - Substrate surfaces must be tested for moisture emissions and Alkalinity prior to starting installation. ASTM-F2170-2 relative humidity probe moisture testing or ASTM-

F1869 calcium chloride testing can be performed to determine the surface moisture emission rate. Alkalinity test per ASTM-F710 should be performed.

1. Acceptable relative humidity probe testing results are up to 90% RH.
2. An acceptable result for calcium chloride moisture testing is up to 5 lbs per 1,000SF per 24 hours.
3. Maximum acceptable pH is 9.0.
4. For test results that determine RH test readings of 90-97%, moisture emission rates of 5lbs-8lbs, or pH readings of 9.0-11, Commercial premium sealer is required.
5. substrate must comply with manufacturer recommended relative humidity, calcium chloride and pH.

F. loose lay carpet tiles within the installation area and allow to precondition for 48 hours prior to installation.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).

C. Install each full carton and complete an entire pallet before starting another pallet to minimize product variation.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet parallel to building lines, with pile direction parallel to next unit, in pattern identified on finish drawings.

F. Locate change of color or pattern between rooms under door centerline.

G. Method of adhesion based on installation type and manufacturers recommendations

H. Trim carpet tile neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

A. clean and protect carpet in accordance with manufacturers recommendations.

B. Remove excess adhesive without damage, from floor, base, and wall surfaces.

C. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 68 16 - SHEET CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rug, Custom-fabricated using broadloam roll goods

B. Broadloom entryway walk-off carpet, direct-glued

1.2 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Shop Drawings: Indicate seaming plan, method of joining seams, size of rugs, direction of carpet pile and pattern, location of edge moldings and edge bindings.

C. Samples: Submit two samples 12 by 12 inch minimum in size illustrating color, pattern and construction for each carpet material specified.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet with minimum three years documented experience.

1.4 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

B. Maintain minimum 70 degrees F ambient temperature 24 hours prior to, during and 24 hours after installation.

C. Ventilate installation area during installation and for 72 hours after installation.

PART 2 PRODUCTS

2.1 RUG

A. Carpet, Type Rug:
1. Manufacturer: As indicated on drawings
2. Product: As indicated on drawings
3. Rug size: as indicated on drawings
4. Roll Width: 12 ft.
5. Color: As indicated on drawings..
6. Pattern: As indicated on drawings..
7. Construction: Multi-Level Pattern Cut/Loop
8. Primary Backing: Synthetic

9. Secondary Backing: Ultraloc
10. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
11. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
12. VOC Content: Provide CRI (GLP) certified product
13. Substitutions: Not permitted.

B. Rug Fabrication & Extensions
1. Edge: Solution dyed nylon serging
2. Finished Backing: Apply an additional commerical-grade Ultraloc + Non-skid rubber backing
3. Total Thickness: 0.409 inches post-fabication
4. All cust must be cleanly made along structural pattern rows to prevent fraying or asymemetric pattern shearing.
5. Backing and edge finishes must be applied in a controlled environment using adhesives recommended by Manufacturuer.
6. Edge and non-skid backing to be provided and fabricated by carpet manufacturer

2.2 BROADLOOM WALK-OFF ENTRYWAY CARPET

A. Carpet, Type Entryway Broadloom Walk-off
1. Manufacturuer: As indicated on drawing
2. Roll Width: [12] ft.
3. Color: [As indicated on drawings.].
4. Pattern: [As indicated on drawings.].
5. Construction: Needlebond Hobnail
6. Dye Method: 100% Solution Dyed
7. Primary Backing: Synthetic
8. Secondary Backing: Performance Rubber Backing
9. Finished Pile Thickness: 0.274 inch
10. Average Density 6504 per cu.yd.
11. Total thickness 0.379 inch
12. Tufted Weight: 49.5 oz/sq yd.
13. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
14. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
15. VOC Content: Provide CRI (GLP) certified product.
16. Substitutions: Equal as determined by Owner and Architect

2.3 ACCESSORIES

A. Subfloor Filler: Type recommended by carpet manufacturer.

B. Carpet Adhesive: Recommended by carpet manufacturer; releasable type.

PART 3 EXECUTION

PART 3 EXECUTION

4.1 EXAMINATION

A. RUG - Verify that floor surfaces are clean, dry, level and free of defects prior to installing the finished rug.

B. BROADLOOM WALK-OFF ENTRYWAY CARPET
1. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesives to subfloor surfaces.

2. Walk-off - Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
3. Test in accordance with Section 09 05 61.
4. Walk-off - Verify that required floor-mounted utilities are in correct location.

4.2 PREPARATION

A. RUG - Clean substrate.

B. BROADLOOM WALK-OFF ENTRYWAY CARPET
1. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.
2. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
3. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
4. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

4.3 INSTALLATION

A. GENERAL
1. Starting installation constitutes acceptance of floor conditions.

B. RUG - Position rug precisely according to the design layout drawings. Ensure it lies completely flat without ripples or curled edges.

C. BROADLOOM WALK-OFF ENTRYWAY CARPET
1. Install carpet in accordance with manufacturer's instructions and CRI 104 (Commercial).
2. Walk-off - Verify carpet match before cutting to ensure minimal variation between dye lots.
3. Lay out carpet and locate seams in accordance with shop drawings.
   a. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
   b. Do not locate seams perpendicular through door openings.
   c. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
   d. Locate change of color or pattern between rooms under door centerline.
   e. Provide monolithic color, pattern, and texture match within any one area.
4. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.
5. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to cut edges of woven carpet immediately.
6. Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.
7. Apply seam adhesive to the base of the edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.
8. Roll with appropriate roller for complete contact of adhesive to carpet backing.
9. Trim carpet neatly at walls and around interruptions.
10. Complete installation of edge strips, concealing exposed edges.

4.4 CLEANING & PROTECTION

A. Clean and protect in accordance with Manufacturuers recommendations

B. vacuum carpet surfaces.

C. Cover with a breathable protective non-staining building material paper if construction traffice continues in the space. Do not use plastic film which can trap adhesive vapors or moisture.

D. Place plywood over carpet when heavy objects are moved.

END OF SECTION

SECTION 09 72 00 - WALL COVERINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Wall covering.

1.2 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide data on wall covering.

C. Shop Drawings: Indicate wall elevations with seaming layout.

D. Samples: Submit two samples of wall covering, 12 by 12 inch in size illustrating color, finish, and texture.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Wall Covering Materials: 25 linear feet of each color and pattern of wall covering; store where directed.
   2. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability. wallcovering and adhesive to be in unbroken and undamaged containers and clearly marked with suppliers identification label.

B. Store in clean dry area with temperature maintained in range recommended by manufacturer. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.5 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.1 WALL COVERINGS

A. General Requirements:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.

B. Wall Covering - Type II: Fabric-backed vinyl roll stock.
   1. Comply with ASTM F793/F793M, Category V, Type II.
   2. Total Weight: Refer to Drawings
   3. Roll Width: Refer to Drawings
   4. Backing: Refer to Drawings
   5. Color: Refer to Drawings
   6. Pattern: Refer to Drawings
   7. Pattern Match: Refer to Drawings
   8. Repeat: Refer to Drawings
   9. Manufacturers: Refer to Drawings, no subsitutions

C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

D. Termination Trim: Extruded plastic, color as selected.

E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

F. Substrate Primer and Sealer: As recommended by adhesive and wallcovering manufacturers and compatible with substrate.

G. Substrate Primer and Sealer: Alkyd enamel type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering and adhesive manufacturers.

3.2 PREPARATION

A. Prepare surfaces in accordance with manufacturers requirements and recommendations.

B. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

C. Surfaces: Correct defects and clean surfaces that affect work of this section.

D. Apply one coat of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth.

E. Vacuum clean surfaces free of loose particles.

3.3 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall surface immediately prior to application of wall covering.

C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

D. Butt edges tightly.

E. Overlap adjacent panels as recommended by manufacturer.

F. Horizontal seams are not acceptable.

G. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

H. Install termination trim.

I. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.4 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Upon completion of work, remove surplus materials, rubbish and debris, resulting from the wallcovering installation. Leave area in neat, clean and orderly condition.

3.5 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

SECTION 09 84 00 – ACOUSTIC ROOM COMPONENTS – MOBILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Acoustic Mobile

1.2 SUBMITTALS

A. Product Data: Manufacturer's printed data sheets for products specified.

B. Shop Drawings: Fabrication and installation details, showing layout, anchorage & accessories, finish colors and textures..

C. Verification Samples: Fabricated samples of one strand showing construction and materials.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with at least three years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store and handle materials in accordance with manufacturers recommendations.

B. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.

D. Store units in dry, well-ventilated space..

E. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.5 FIELD CONDITIONS

A. Sequence work to ensure acoustical units are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested and approved.

B. Do not install panels until wet work is complete, the building is enclosed, and temperature and relative humidity are stabilized at 60-80 degrees F and 35% minimum RH and 55% maximum RH, respectively.

PART 2 PRODUCTS

2.1 FABRIC-COVERED SOUND-ABSORBING UNITS

A. Manufacturers:
   1. LIghtArt; https://lightart.com/

B. Product:
   1. Custom Acoustic Mobile

Design Quote Van Buren Charter Township

PID 470327

DATE PREPARED
(VALID 30 DAYS)

Aug 27, 2026

INSPIRATION IMAGE - VALLARTA SUPERMARKET HQ

Design Quote Van Buren Charter Township

PID 470327

DATE PREPARED
(VALID 30 DAYS)

Aug 27, 2026

CONCEPT RENDER

Design Quote Van Buren Charter Township

PID 470327

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CONCEPT RENDER

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An acoustic mobile of (34) Strands with folded felt shapes

QUANTITY	(1) Acoustic felt mobile with (34) strands, between (4) and (6)shapes per strand
DIMENSIONS	Approx. 18'L x 12'H x 8'H
EST. LEAD TIME	10-12 weeks

Materials

ACOUSTIC FELT	(186) 6" x 6" folded acoustic felt squares in (2) colors

Lighting

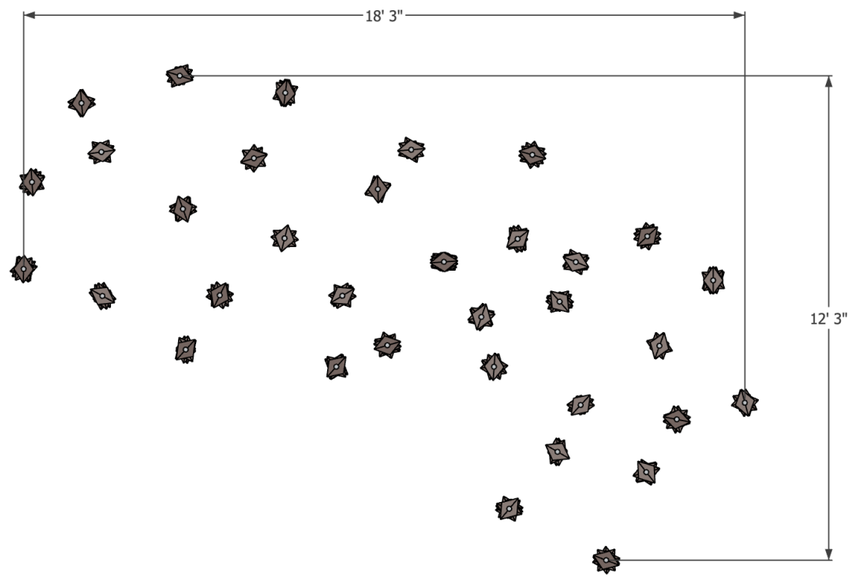
No Lighting Provided

Hardware

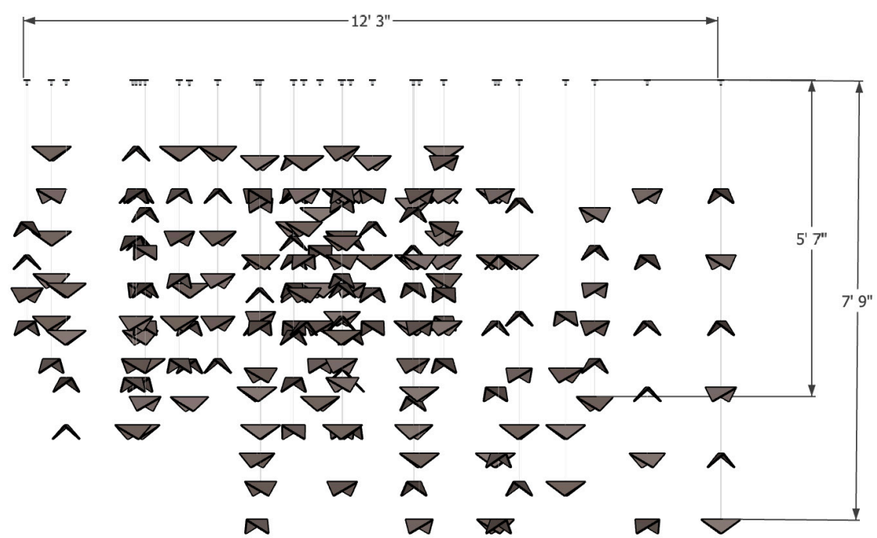
(34) Stainless steel cables to ceiling, adjustable 12" – 96"
Cable Couplers attach to 1/4"-20 threaded rods in ceiling (*provided by others*)

Freight

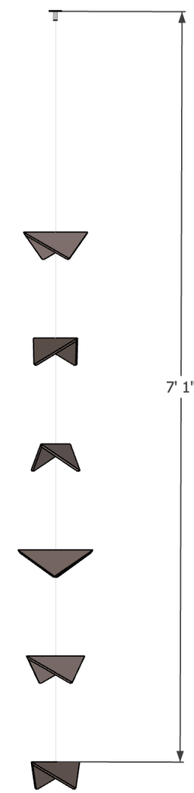
Freight Allowed



TOP VIEW



SIDE VIEW



EXAMPLE STRAND DIMENSIONS

DUNE

DRIFTWOOD

FELT COLORS IN MODEL

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates for conditions detrimental to installation of mobiles. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install acoustic mobiles in locations as indicated, following manufacturer's installation instructions.

B. Install mounting accessories and supports in accordance with shop drawings.

3.3 CLEANING

A. Follow manufacturer's instructions for cleaning. replace products that cannot be cleaned to as new condition.

B. Clean mobiles upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.4 PROTECTION

A. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect and Owner.

END OF SECTION

SECTION 09 84 30 - SOUND-ABSORBING WALL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sound-absorbing panels.

1.2 SUBMITTALS

A. Product Data: Manufacturer's printed data sheets for products specified.

B. Shop Drawings: Fabrication and installation details, showing layout, edge profies, panel components including anchorage & accessories, finish colors and textures, wood grain orientation, fabric orientation.

C. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and material.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with at least three years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in maurfacturuer's original, unopened, undamaged containers with identification lables intact.

B. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.

C. Store units flat, in dry, well-ventilated space; do not stand on end.

D. Protect edges from damage.

E. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturuer.

F. Store and handle materials in accordance with manufacturuers recommendations.

1.5 FIELD CONDITIONS

A. Sequence work to ensure acoustical units are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is compeleted, tested and approved.

B. Do not install panels until wet wrok is complete, the building is enclosed, and temperature and relative humidity are stablized at 60-80 degrees F and 35% minimum RH and 55% maximum RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herin prior to installation to allwo material stablization.

PART 2 PRODUCTS

2.1 FABRIC-COVERED SOUND-ABSORBING UNITS

A. Manufacturers:
1. Kinetics Noise Control, Inc.,www.kineticsnoise.com, (614) 889-0480..
a. Product: as Indicated on drawings.
b. Acceptable alternate Manufacturers:
1) Conwed, wall panels, www.conwed.com
2) Sound Seal, S-2000, www.soundseal.com

B. General:
1. Prefinished, factory assembled fabric-covered panels.
2. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

C. Fabric-Covered Acoustical Panels for Walls: (FWP) on drawings.
1. Panel Core: Manufacturer's standard rigid or semi-rigid fiberglass core.
2. Core Density: 6 to 7 lb/cu ft.
3. Sound Absorption: Noise Reduction Coefficient (NRC) of 1.00 min when tested in accordance with ASTM C423.
4. Panel Size: Custom, refer to interior elevations.
5. Panel Thickness: 2 inches.
6. Edges: Perimeter edges reinforced by a formulated resin hardener.
7. Corners: Square.
8. Fabric: As indicated on drawings..
9. Color: As indicated on drawings.
10. Patterns: Where fabric with directional or repeating patterns or fabric with directional weave is used, mark for installation in same direction.
11. Mounting Method: Back-mounted with mechanical fasteners. z-clips, quantity, location and spacing as recommended by manufacturer.

2.2 WOOD WALL PANEL, SOUND ABSORBING ACOUSTIC UNITS

A. Manufacturers:
1. TerraMai, www.terramai.com, 800.220.9062
2. or equal as determined by owner and architect

B. Wood Slats on Acoustic Board Panels for Walls: (WWP) on drawings.
1. prefinished, factory assembled acoustic wall panels constructed of natural, solid wood assembled on rigid acoustic board.
2. Product: As indicated on drawings
3. Construction: Eight slats 1" wide x 1/2" deep x 94-1/2" long spaced 1/2" apart installed on a 3/8" thick x 12" wide 94-1/2" long rigid acoustic board.
4. Species: As Indicated on drawings
5. Finish: As indicated on drawings
6. Color: As indicated on drawings
7. Sound Absorption: As indicated on drawings
8. Backer: 3/8" Rigid PET Felt
9. Mounting Method: Adhered and mechanically fastened with screws. adhesive and fastners to comply with manufacturuers recommendations.

2.3 THERMOBONDED SOUND-ABSORBING MONOMATERIC RELIEF PANELS

A. Manufacturuers
1. Slalom, slalom-it.com

B. Thermobonded sound-absorbing monomateric relief panels (AP1 & 2) on drawings.
   1. prefinished, factory assembled acoustic wall panels
   2. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   3. Material: PET, polyethylene terephthalate assembled on PET backer
   4. Product: as indicated on drawings
   5. Construction, monomateric material over backer of same material.
   6. Sound Absorption: Noise Reduction Coefficient (NRC) of 0.9 when tested in accordance with ASTM C423.
   7. Thickness: Varies, see drawings
   8. Fabric: As indicated on drawings
   9. Color: As indicated on drawings
   10. Mounting Method: Velcroed to backing material which is Adhered and mechanically fastened with screws to substrate. All/any.adhesive and fastners to comply with manufacturuers recommendations.

2.4 POLYESTER FIBER ACOUSTIC PANEL, CUSTOM PRINTED DIGITAL MURAL

A. Manufacturuers
   1. Momentum

B. 100% Polyester panel with custom printed mural (AP3) on drawings.
   1. prefinished, factory printed acoustic wall panels.
   2. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   3. Material: PET, polyethylene terephthalate
   4. Product: As indicated on drawings
   5. Sound Absorption: Noise Reduction Coefficient (NRC) of 0.8 when tested in accordance with ASTM C423.
   6. Thickness: As indicated on drawings
   7. Color: As indicated on drawings
   8. Mounting Method: direct adhered to substrate. Adhesive to comply with manufacturuers recommendations.

2.5 ACCESSORIES

A. FWP: Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
   1. Z-clip system with one piece secured to substrate with screws and the other mounted into back of panel with impaling prongs.

B. WWP & AP: Panel Adhesive: Acceptable to acoustical panel manufacturer for application as indicated.
   1. high quality adhesive with manufacturer recommendations for the application and compatibility with rigid polyester PET felt and the substrate.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Install mounting accessories and supports in accordance with shop drawings.

C. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

D. Install acoustical units in uniform plane and free from twist, warp and dents.

E. Fit acoustical units in place, free from damaged edges, or other defects detrimental to appearance and function.

F. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
   1. Plumb and level.
   2. Flatness.
   3. Width of joints.

G. Field cutting of Fabric Wrapped Panels to conform with manufacturers Field Cut and Rewrap installation instructions.

3.3 CLEANING

A. Follow manufacturer's instructions for cleaning panels soiled during installation. replace panels that cannot be cleaned to as new condition.

B. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.4 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Keep site free from accumulation of waste and debris.

C. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect and Owner.

END OF SECTION

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.
   2. Mechanical and Electrical:
      a. Paint equipment, including piping and supports, that is exposed to weather or to view except fully factory-finished equipment.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
   7. Marble, granite, slate, and other natural stones.
   8. Floors, unless specifically indicated.
   9. Ceramic and other types of tiles.
   10. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
   11. Exterior insulation and finish system (EIFS) unless specificaly indicated to do so.
   12. Glass.
   13. Concealed pipes, ducts, and conduits.

E. Coatings for exposed areas of Parking Decks/ Garages, except traffic coatings and striping.

1.2 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting.

1.3 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.
2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.

C. Maintenance Data: Submit data including product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Paint and Finish Materials: All unused (non-returnable / non-refundable) and / or remaining partially used paint of each color and sheen. Note: Additional quantities of new unopened gallons of paint for each paint color and sheen is not required.
2. Label each container with color in addition to the manufacturer's label.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.7 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
   1. Basis of Design Manufacturer: Sherwin-Williams Company.
   2. Pittsburgh Paints.
   3. Benjamin Moore Paints.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Colors: As indicated on drawings.
   1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

2.3 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

H. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.

G. Sand metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.6 SCHEDULE - PAINT SYSTEMS

A. Ferrous Metals, Unprimed:
   1. One coat Pro Industrial Pro Cryl Universal Primer, B66 Series.
   2. Semi-gloss: Two coats Pro Industrial Waterbased Alkyd Urethane Enamel, B53 Series.

B. Ferrous Metals, Primed:
   1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer for the substrate and existing primer.
   2. Semi-gloss: Two coats Pro Industrial Waterbased Alkyd Urethane Enamel, B53 Series.

C. Galvanized Metals:
   1. One coat Pro Industrial Pro Cryl Universal Primer, B66 Series.
   2. Semi-gloss: Two coats Pro Industrial Waterbased Alkyd Urethane Enamel, B53 Series.

D. Aluminum:
   1. One coat Pro Industrial Pro Cryl Universal Primer, B66 Series.
   2. Semi-gloss: Two coats; Pro Industrial Waterbased Alkyd Urethane Enamel, B53 Series.

END OF SECTION

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Prime surfaces to receive wall coverings.
   3. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In finished areas, paint shop-primed items.
      c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
      d. Paint dampers exposed behind louvers, grilles, to match face panels.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
   9. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
   10. Glass.
   11. Acoustical materials, unless specifically indicated.
   12. Concealed pipes, ducts, and conduits.

1.2 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.3 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. Cross-reference to specified paint system products to be used in project; include description of each system.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.

C. Maintenance Data: Submit data including product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Paint and Finish Materials: All unused (non-returnable / non-refundable) and / or remaining partially used paint of each color and sheen. Note: Additional quantities of new unopened gallons of paint for each paint color and sheen is not required.
   2. Label each container with color in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
1. Basis of Design Manufacturer: Sherwin-William Company.
2. Pittsburgh Paints.
3. Benjamin Moore Paints.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each paint material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
b. USGBC LEED Rating System for interior wall and ceiling finishes (all coats), anti-corrosive paints on interior ferrous metal, sanding sealers, other sealers, and floor coatings.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Colors: As indicated on drawings.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

2.3 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

I. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces to Remain Primed Finish: Sand and scrape to remove loose primer, rust, loose mill scale, weld splatter, dirt and other foreign substances, according to SSPC-SP 3 Power Tool Cleaning. Clean surfaces with solvent. Prime bare steel surfaces.
   3. Shop-Primed Surfaces (Uncorroded) to be Finish Painted: Sand and scrape to remove loose primer, grease, dirt and other foreign substances, according to SSPC-SP 3 Power Tool Cleaning. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

4. Shop-Primed Surfaces (Corroded) to be Finish Painted: Remove loose primer, rust, loose mill scale, weld splatter, dirt and other foreign substances, according to SSPC-SP 6 Commercial Blast Cleaning. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
5. Uncorroded, Un-coated Surfaces to be Finish Painted: Remove grease, rust, loose mill scale, weld splatter, dirt and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

J. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

K. Metal Door Frames to be Painted: Prime metal door frame edge surfaces.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately using spray application.

B. Spray application of paints and coatings inside the building, regardless of state of enclosure, is not permitted without prior written permission. Except where dryfall coatings are specified.

C. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

D. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

E. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

F. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

G. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

H. Sand wood and metal surfaces lightly between coats to achieve required finish.

I. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

J. Wood to Receive Transparent Finishes: Refer to Division 09, Staining and Transparent Finishing.

K. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.6 SCHEDULE - PAINT SYSTEMS

A. Dryfall: Exposed structure and overhead-mounted services including steel deck, structural steel, metal fabrications, metallic ducts, metallic conduit, and piping.
   1. Flat: Two coats; ProIndustrial Waterborne Acrylic Dryfall B42 Series.

B. Ferrous Metals, Unprimed, Acrylic Epoxy, 3 Coat:
   1. One coat primer; ProIndustrial Pro-Cryl Universal Acrylic Primer B66 Series.
   2. Semi-gloss: Two coats of latex enamel; ProIndustrial PreCatalyzed Waterbased Semi-Gloss Epoxy K46 Series.

C. Ferrous Metals, Primed, Acrylic Epoxy, 2 Coat:
   1. Touch-up with primer as recommend by top coat manufacturer for substrate and existing primer.
   2. Semi-gloss: Two coats of latex enamel; ProIndustrial PreCatalyzed Waterbased Semi-Gloss Epoxy K46 Series.

D. Ferrous Metals, Handrails and Guards, Acrylic Epoxy, 3 Coat:
   1. One coat primer; ProIndustrial Pro-Cryl Universal Acrylic Primer B66 Series.
   2. Gloss; Two coats of latex enamel; ProIndustrial Waterbased Catalyzed Gloss Epoxy B73 Series.

E. Galvanized Metals, Acrylic Epoxy, 3 Coat:
   1. One coat primer; ProIndustrial Pro-Cryl Universal Acrylic Primer B66 Series.
   2. Semi-gloss: Two coats of latex enamel; ProIndustrial PreCatalyzed Waterbased Semi-Gloss Epoxy K46 Series.

F. Gypsum Board, Latex, 3 Coat:
   1. One coat of latex primer sealer; ProMar 200 Zero VOC Interior Latex Primer B28 Series.
   2. Eg-Shel: Two coats latex enamel; ProMar 200 Zero VOC Interior Eg-Shel Latex B20 Series.

G. Gypsum Board Ceilings and Soffits, Latex, 3 Coat:
   1. One coat of latex primer sealer; ProMar 200 Zero VOC Interior Latex Primer B28 Series.
   2. Flat: Two coats latex enamel; ProMar 200 Zero VOC Interior Flat Latex B30 Series.

H. Wood, Trim and Paneling, Opaque, Acrylic, 3 Coat:
   1. One coat latex primer sealer; PrepRite ProBlock Latex, B51 Series.
   2. Semi-Gloss: Two coats acrylic; Pro Industrial Acrylic Semi-Gloss, B66 Series.

I. Hollow Metal Door Frames:
   1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.Semi-gloss: Two coats Pro Industrial Waterbased Alkyd Urethane Enamel, B53 Series.FRP Doors and Frames:One coat Extreme Bond Primer, B51 Series.Semi-Gloss: Two coats Pro Industrial Waterbased Alkyd Urethane Enamel, B53 Series.
   2. Semi-gloss: Two coats Pro Industrial Waterbased Alkyd Urethane Enamel, B53 Series.

END OF SECTION

SECTION 09 93 00 - STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Field application of stains and transparent finishes.

1.2 RELATED REQUIREMENTS

A. Section 06 20 000 – Finish Carpentry: Wood species to receive stains and transparent finishes.

1.3 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and catalog number, and general product category.

B. Samples: Submit two samples, illustrating selected colors and sheens for each system with specified coats cascaded. Submit on actual wood substrate to be finished, 4 by 6 inch in size.

C. Maintenance Data: Submit data including product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Stock Materials: Stain and transparent finish materials, 1 gal of each color and type; store where directed.
   2. Label each container with color and type in addition to the manufacturer's label.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.7 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperature: 50 degrees F unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide finishes used in any individual system from the same manufacturer; no exceptions.

B. Transparent Finishes:
1. Base Manufacturer: Sherwin-Williams Company.
2. PPG Paints.

C. Stains:
1. Base Manufacturer: Sherwin-Williams Company.
2. PPG Paints.

2.2 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:
1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each finish material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
1. Provide stains and transparent finishes that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. USGBC LEED Rating System for interior wall and ceiling finishes (all coats), clear wood stains and finishes, sanding sealers, other sealers, shellac, and floor coatings.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Colors: Clear.
   1. Extend colors to all exposed to view surface edges.

2.3 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood Trim:
   1. Stain: Transparent Stain for Wood, Solvent Based; Hardwood Applications. 4 coats.
      a. One Coat; Minwax Performance Series Tintable Wood Stain 250 VOC.
      b. One Coat; Minwax Performance Series Fast-Dry Sanding Sealer.
      c. Two coats; Minwax Performance Series Fast-Dry Satin Varnish.
   2. Stain: Transparent Stain for Wood, Solvent Based; Softwood Applications. 5 coats.
      a. One coat; Minwax Pre-Stain Wood Conditioner Oil Based.
      b. One coat; Minwax Performance Series Tintable Wood Stain 250 VOC.
      c. One coat; Minwax Performance Series Fast-Dry Sanding Sealer.
      d. Two coats; Minwax Performance Series Fast-Dry Satin Varnish.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin application of stains and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

G. Wood Surfaces to Receive Opaque Finish: Refer to Division 09, Interior Painting.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

G. Reinstall items removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 21 13.16 - PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. High pressure, plastic laminate toilet compartments.

1.2 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Concealed steel support members.

B. Section 06 10 00 - Rough Carpentry: Blocking and supports.

C. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

A. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall, floor, and ceiling supports, door swings.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Samples: Submit one samples of partition panels, 6 x 6 inch in size illustrating panel finish, color, and sheen. Sample will be retained at Architect's office and not returned to Contractor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. High Pressure, Plastic Laminate Toilet Compartments:
   1. Basis of Design: Ironwood Manufacturing, High Pressure Laminate Partitions.
   2. Subject to compliance with requirements, equivalent products of the following manufacturers may be reviewed by Architect for acceptance:
      a. All American Metal Corp - AAMCO.
      b. ASI Accurate Partitions.
      c. General Partitions Mfg. Corp.
      d. Metpar Corp.
      e. Global Steel Products Corp.

2.2 MATERIALS

A. Engineered Wood Board for Core: ANSI A208.1 composed of wood chips, sawdust or flakes, made with waterproof resin binder; of grade to suit application; sanded faces. 45-pound per cubic foot density, minimum.

B. Plastic Laminate: NEMA LD 3, HGS.

C. Adhesive: Manufacturer's standard type.

2.3 COMPONENTS

A. Toilet Compartments: Plastic laminate finished, floor-to-ceiling.

B. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces and edges of particleboard core, with beveled corners and edges; edges of cut-outs sealed.
   1. Reinforce pilasters and panels with steel plate sandwiched in particleboard core at attachment points. Router cut openings as required.
   2. Provide edge banding fused to the substrate to create a seamless beveled profile with increased resistance to moisture and humidity.
   3. Provide manufacturer, zero-sight line, lap joint at door / pilaster jamb.
   4. Plastic Laminate Colors: Single color, including finish, for doors and panels as indicated on Drawings.

C. Door and Panel Dimensions:
   1. Door Thickness: 1-1/4 inch, minimum
   2. Side Panel Thickness: 3/4 inch, minimum.
   3. Pilaster Thickness: 1-1/4 inch, minimum.
   4. Door Width: 30 inch.
   5. Door Width for Handicapped Use: 36 inch , out-swinging.
   6. Door and Side Panel Height: 84 inch. Door and Side Panels to be mounted 9" above finish floor.
   7. Height of Pilasters: Floor to ceiling, 1 inch less than finished ceiling, refer to Drawings for ceiling height.

2.4 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with black powder coat finish, 3 inches high, concealing floor fastenings and head bracket.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
   2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.

B. Head Brackets: Manufacturer’s standard L-Brackets, attached to above-ceiling framing.

C. Brackets: stainless steel with black powder coat finish Provide continuous no-sight line panel brackets at side panel to wall and side panel to pilaster.

D. Attachments, Screws, and Bolts: Stainless steel with black powder coat finish, tamper proof type.
   1. For attaching panels and pilasters to brackets: Single sided screw .

E. Steel Plate Reinforcement: Carbon steel, prepared for fasteners, 1/8 inch thick.

F. Hardware: stainless steel with black powder coat finish:
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Nylon bearings.

3. Door latch: Thumb turn or sliding door latch with exterior emergency access feature and occupancy indicator.
4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
5. Coat hook with rubber bumper: one per compartment, mounted on inside face of door. Coat hook manufacturer, style, and finish as indicated on Drawings.
6. Provide door pull for outswinging doors.

2.5 FINISHES

A. Stainless Steel with Black Powder Coat: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat, and two finish coats of powder coat enamel.
   1. Roughen the stainless steel substrate via sandblasting as required for powder coating adhesion.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that field measurements are as indicated on shop drawings.

C. Verify correct spacing of and between plumbing fixtures.

D. Verify correct location of built-in framing, anchorage, and bracing.

E. Coordinate the work with placement of support framing and anchors in walls and ceilings.

3.2 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using zero sight line anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 22 39 - FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Top-supported folding panel partitions, horizontal opening.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking and track support shimming.

B. Section 08 71 00 - Door Hardware: Lock cylinders for panels

C. Section 26 05 20 – Conductors and Cables 600V And Below: Feeder for the controller.

D. Section 26 05 34 - Conduit Raceways for Electrical Systems: Empty conduit from partition motor controller to disconnect and from motor controller to control buttons. Feeder conduit for the controller.

1.3 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

D. ASTM E413 - Classification for Rating Sound Insulation; 2022.

E. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions; 2012 (Reapproved 2026).

F. ASTM F793/F793M - Standard Classification of Wall Coverings and Ceiling Coverings by Use Characteristics; 2025.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
   1. Require attendance by representatives of installer.

1.5 SUBMITTALS

A. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.

B. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

C. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.

D. Samples for Review: Submit one samples of surface finish, 12 by 12 inches size, illustrating quality, colors selected, texture, and weight. Sample will be retained at Architect's office and not returned to Contractor.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.8 WARRANTY

A. Provide ten year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Folding Panel Partitions - Horizontal Opening:
   1. Basis of Design: Modernfold, a DORMA Group Company: Acousti-Seal Legacy - Electric Panel.
   2. Kwik-Wall Company.
   3. Moderco, Inc.

2.2 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Folding Panel Partitions: Side opening; individual panels; side stacking; motor operated.

B. Panel Construction:
   1. Frame: 16 gauge, 0.0598 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
   2. Panel Substrate Facing: Manufacturer's standard thickness roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction.
   3. Hinges for Panels, Closure Panels, Pass Doors, and Pocket Doors shall be full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support

hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.

4. Panel Properties:
   a. Thickness With Finish: 3 inches.
   b. Width: Equal widths.
   c. Weight: 8 lb/sq ft.
   d. Acoustical Rating: 50 STC.

C. Final Closure: Side jamb with overlapping trail panel.

D. Panel Finishes:
1. Facing: Textile fabric wallcovering, FB1 as indicated on Drawings.
2. Exposed Metal / Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.

E. Panel Seals:
1. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable. Color to match panel finish.
2. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
3. Horizontal bottom floor seals shall be:
   a. Automatic operable seals providing nominal 2-inch (51 mm) operating clearance with an operating range of +1/2-inch (13 mm) to –1-1/2 inch (38 mm) which automatically drop as panels are positioned, without the need for tools or cranks.

F. Suspension System:
1. Track: Minimum 7-gage, 0.18-inch (5 mm) roll-formed steel. Track shall be supported by adjustable steel hanger brackets connected to structural support by pairs of 1/2-inch (13 mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
   a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white.
2. Carriers: All-steel trolleys with steel-tired ball bearing wheels.

G. Floor Guide:
1. Recessed Floor Track: Manufacturer’s standard alignment guide.

H. Performance:
1. Acoustic Performance:
   a. Sound Transmission Class (STC): 48 to 52 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.
2. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span or 1/8 inch per 12 feet, non-cumulative, whichever is more stringent.

I. Operation:
1. Electric Operator: 12 inches per second traveling speed; adjustable friction clutch brake actuated by solenoid controlled motor starter; enclosed limit switch; enclosed magnetic reversing starter.
2. Control Station: Two standard keyed, three button STACKED-OFF-EXTEND type; 24 volt circuit; surface mounted.
   a. Key switch prepared for mortise lock cylinder.
   b. Key switches alike.
3. Safety Features:
   a. Limit Switches: Automatic type, at both extremes of travel, to prevent over-travel.
   b. Emergency Release: Mechanism to disengage motor drive system and permit manual operation.

c. Pocket Door Interlock: Mechanism to prevent operation of panels unless storage pocket doors are fully open.

4. Electrical Requirements:
   a. Motor unit shall be reversible, continuous duty, and class A insulated. Motor unit shall have NEMA MG 1 service factor, high starting torque, thermal overload protection, and open/drip proof enclosure. Motor assembly shall have wiring compliant with NFPA 70, 24-volt controls, compliant with UL 508A, and speed of 28 feet/minute. The drive unit motor shall be equipped with outboard limit switches to prevent over-extension. A positive chain drive attached to the lead panel shall pull the partition across the opening. Cable, belt, or other friction type drives will not be accepted.
   b.
   c. 1 hp Drive Unit.
   d. 208-230 volts, three phase, 60 Hz.
   e. 4.5 Full Load Amps
   f. Conduit and Outlet Boxes: Concealed type in accordance with Division 26, Conductors and Cables - 600V And Below and Division 26, Raceways for Electrical Systems.
   g. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
   h. Disconnect Switch: Factory mount disconnect switch in control panel.

J. Accessories:
   1. Ceiling Closure: White enameled ceiling closure; aluminum jamb and head molding, fittings and attachments, and intermediate meeting posts.
   2. Pocket Enclosures: Door, frame, and trim to match adjacent panels with keyed lock.
   3. Acoustic Sealant: As recommended by partition manufacturer.
   4. Primer: Factory paint all concealed steel with manufacturer's standard rust-inhibiting primer.

2.3 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Vinyl Coated Fabric: ASTM F793 Category VI, polyvinyl fluoride (PVC) finish for washability and improved flame retardance; color as selected by Architect from manufacturer's standard range.

C. Acoustic Insulation:
   1. Type: As required for acoustic performance indicated.
   2. Thickness: As required for acoustic performance indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated and as required by the manufacturer.

B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.

C. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

D. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.

E. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

3.2 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Install electric operator, wiring, and controls. Locate control station(s) as indicated.

C. Fit and align partition assembly and pocket doors level and plumb.

D. Install recessed floor guide track, flush with finished floor surface.

E. Lubricate moving components.

F. Install acoustic sealant to achieve required acoustic performance.

G. Coordinate electrical connections.

H. Touch up damaged factory finishes for coated or painted materials.

I. Replace all damaged, dented and destroyed door panel faces.

3.3 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

3.4 CLEANING

A. Clean finish surfaces and partition accessories.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Commercial toilet accessories.

B. Electric hand/hair dryers.

C. Diaper changing stations.

D. Utility room accessories.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Concealed blocking / support for accessories.

B. Section 22 40 00 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.3 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

B. ASTM C1036 - Standard Specification for Flat Glass; 2021.

C. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.5 SUBMITTALS

A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories: Provide the basis of design products as scheduled on the drawings or an equivalent product to the basis of design, by one of the following:
   1. AJW Architectural Products.
   2. American Specialties, Inc.
   3. Bobrick Washroom Equipment, Inc.
   4. Bradley Corporation.

B. Electric Hand/Hair Dryers: Provide the basis of design products as scheduled on the drawings or an equivalent product to the basis of design, by one of the following:
   1. Bobrick Washroom Equipment, Inc.
   2. Excel Dryer.
   3. Frost Products Limited.
   4. World Dryer Corporation.

C. Diaper Changing Stations: Provide the basis of design products as scheduled on the drawings or an equivalent product to the basis of design, by one of the following:
   1. American Specialties, Inc.
   2. Bradley Corporation.
   3. Diaper Deck & Company.
   4. Koala Kare Products.
   5. Safe-Strap Company, Inc.

D. Mop / Broom Holder: Provide the basis of design products as scheduled on the drawings or an equivalent product to the basis of design, by one of the following:
   1. AJW Architectural Products.
   2. American Specialties, Inc.
   3. Bobrick Washroom Equipment, Inc.
   4. Bradley Corporation.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide 6 keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666/A666M, Type 304 with finish as indicated on Drawings.

D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

E. Adhesive: Two component epoxy type, waterproof.

F. Fasteners, Screws, and Bolts: Stainless steel; tamper-proof; security type.
   1. Finish:
      a. Finish to match stainless steel finish of accessory to which fastener, screw or bolt is being utilized for.
      b. Exposed to view through-bolts in toilet partition panels: Black powder coat finish.
   2. Accessories mounted to toilet partition panels:
      a. Through-bolts are only acceptable for grab bar installation.
      b. Single sided fasteners, and screws are to be utilized for all other accessories, including but not limited to, toilet paper dispenser, coat hooks, and sanitary napkin disposal units.

G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.4 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Specified in Division 22, Plumbing Fixtures.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

D. Verify that field measurements are as indicated on drawings.

E. Refer to Division 06, Rough Carpentry, for installation of blocking in walls and ceilings.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on Drawings.

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 31 00 - MANUFACTURED FIREPLACES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured steel box fireplace.

B. Intake vent and exhaust fan / duct and associated flashings.

1.2 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory; Current Edition.

B. UL 127 - Standard for Factory-Built Fireplaces; Current Edition, Including All Revisions.

1.3 SYSTEM DESCRIPTION

A. Pre-manufactured two sided (interior and exterior), see thru, gas fireplace.

B. Built-in firebox with concealed flue; rectangular shape; gas starter and circulating fan.

1.4 SUBMITTALS

A. Product Data: Provide fire box cabinet dimensions, clearances required from adjacent dissimilar construction, applicable regulatory agency approvals, electrical characteristics of fan.

B. Shop Drawings: Indicate fire box rough opening dimensions, rough opening sizes for chimney flue, and fan size.

C. Manufacturer's Certificate: Certify that fireplace components meet or exceed UL (DIR) requirements.

D. Manufacturer's Instructions: Indicate installation procedures and component installation sequence, clearances and tolerances from adjacent construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufactured Fireplaces:
1. Basis of Design: DaVinci Custom Fireplace; Model See-Thru, 60 inches long x 20 inches deep with 36 inches glass height. Vented with "safe to touch" glazing.
2. Heat & Glo.
3. Lennox Hearth Products.
4. Vermont Castings.

2.2 REGULATORY REQUIREMENTS

A. Comply with applicable code for clearances from adjacent materials, chimney height above roof line requirements, and unit UL approval.

B. Listed by Underwriters Laboratories Inc. (UL) as complying with UL 127.

C. Products Requiring Electrical Connection: Listed and labeled by UL (DIR) or testing firm acceptable to authorities having jurisdiction, as suitable for the purpose specified and indicated.

2.3 COMPONENTS

2.4 FACTORY FINISHING

A. Exposed to View Surfaces: Baked enamel, color as selected by Architect from manufacturer's full range of colors.

2.5 ACCESSORIES

A. Extruded aluminum, exterior window kit.

B. Touch screen wall control panel.

C. Interior Fire Art: Traditional log set.

D. Liner: Standard matte black paint.

E. Burner Decor: Rock ember.

F. Firestop Spacer: Non-combustible device designed to fit between vent riser and penetrated wall / roof construction framing.

G. Circulating Fans: Motor and fan, UL approved, 120 volts.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that prepared openings are ready to receive work and opening dimensions are as indicated on drawings.

B. Verify that proper power supply and fuel source are available.

3.2 INSTALLATION

A. Install unit assembly in accordance with manufacturer's instructions.

B. Install intake vent and exhaust fan / duct plumb through prepared roof openings using fire stop spacers.

C. Secure intake vent and exhaust fan / duct in opening framing with appropriate fasteners.

D. Carefully cut holes for wall controls, intake vent and exhaust fan / duct.

E. Install roof flashings to ensure moisture is shed away from vent and fan.

3.3 TOLERANCES

A. Maximum Variation of Chimney From Plumb: 1/2 inch.

END OF SECTION

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 06 41 00 – Architectural Wood Casework: Fire extinguishers installed inside wood cabinets.

C. Section 09 91 23 - Interior Painting: Field paint finish.

1.3 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

1.4 SUBMITTALS

A. Product Data: Provide extinguisher operational features.

B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, mounting measurements for wall bracket, and accessories required for complete installation.

1.5 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguishers:
1. Amerex Corporation; www.amerex-fire.com/#sle.
2. Ansul, a Tyco Business: www.ansul.com/#sle.
3. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
4. Nystrom, Inc: www.nystrom.com/#sle.

B. Fire Extinguisher Cabinets and Accessories:
1. Amerex Corporation; www.amerex-fire.com/#sle.
2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
3. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
4. Nystrom, Inc: www.nystrom.com/#sle.

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Aluminum tank, with pressure gauge.
   1. Stored Pressure Operated: Deep Drawn.
   2. Class: 2-A:10-B:C. Confirm class with AHJ / Fire Marshal prior to fire extinguisher buyout.
   3. Size: 10 pound. Confirm class with AHJ / Fire Marshal prior to fire extinguisher buyout.
   4. Finish: Baked polyester powder coat, color as selected.
   5. Temperature range: Minus 65 degrees F to 120 degrees F.

2.3 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction: Non-fire rated.
   1. Formed primed steel sheet; 0.036 inch thick base metal.

B. Cabinet Configuration: Semi-recessed type. Type location as indicated on Drawings.
   1. Size to accommodate accessories.
   2. Trim: Flat rolled edge.

C. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

D. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

E. Fabrication: Weld, fill, and grind components smooth.

F. Finish of Cabinet Exterior Trim and Door: Primed for field paint finish.

G. Finish of Cabinet Interior: White colored enamel.

H. Finish of Cabinet Hardware: Stainless steel with No. 4 finish.

2.4 ACCESSORIES

A. Extinguisher Brackets:
   1. Architectural Wood Casework Mounted: Formed steel, galvanized and enamel finished, color red.
   2. Fire Extinguisher Cabinet Mounted: Formed steel, manufacturer standard finish.

B. Lettering:
   1. Fire Extinguisher Cabinets: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ). Lettering to be supplied and installed after field painting.
   2. Architectural Wood Casement: FIRE EXTINGUISHER lettering as indicated on Drawings and in accordance with authorities having jurisdiction. Lettering to be supplied and installed after casework installation and finishing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 48 inches from finished floor to top of extinguisher cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

3.3 MAINTENANCE - SELF-SERVICE FIRE EXTINGUISHERS

A. Annual Inspections: Inspect self-service fire extinguishers on annual basis in accordance with manufacturer’s instructions, and requirements of the authorities having jurisdiction (AHJ).

B. Inspection Certification Tag: Provide new tag indicating acceptable condition of fire extinguisher, date of inspection, and name of self-service inspector for each inspection.

END OF SECTION

SECTION 107500 – SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.2 WORK INCLUDED:

A. Provide all labor, materials, necessary equipment and services to complete the Site Furnishings work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS".

B. Including, but not Necessarily Limited to, the Following:

1. 4’-0” ht. Ornamental Aluminum Fencing and Gates
2. 3’-6” ht. Ornamental Aluminum Guardrail, type GDRL-1
3. 3’-6” ht. Ornamental Aluminum Guardrail, type GDRL-2

1.3 SUBMITTALS:

A. Manufacturer's Data:

1. Descriptive data of installation, methods procedures and maintenance.

B. Complete shop drawings for all items of work under this section indicating all details of fabrication and installation, including sizes, shapes, finishes, colors, thickness, material quality and all other related work applicable to the items of this section.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Deliver all materials with manufacturer's tags and labels intact.

B. Store and handle so as to avoid damage.

PART 2 - PRODUCTS

2.1 4’-0” HT. ORNAMENTAL ALUMINUM FENCING AND GATES

A. Manufactured By: Elite Fence Products, Inc., www.elitefencestore.com, (800)-878-7829

B. Model: Pool Fence, commercial grade

C. Height: 4’-0"

D. Gates: Per Plans

E. Color: Textured (Matte) Black

2.2 3'-6" HT. ORNAMENTAL ALUMINUM GUARDRAIL (GDRL-1)

A. Manufactured By: Elite Fence Products, Inc., www.elitefencestore.com, (800)-878-7829

B. Model: Elite Core Railing System, commercial grade

C. Height: 3'-6"

D. Width: 6'-0" panels

E. Posts: 2 1/2" square

F. Pickets: 3/4" square

G. Color: Textured (Matte) Black

2.3 3'-6" HT. ORNAMENTAL ALUMINUM GUARDRAIL (GDRL-2)

A. Manufactured By: Elite Fence Products, Inc., www.elitefencestore.com, (800)-878-7829

B. Model: Legacy 158 – Aluminum Railing System, commercial grade

C. Height: 3'-6"

D. Width: 6'-0" panels

E. Posts: 2 1/2" square

F. Pickets: 3/4" square

G. Color: Textured (Matte) Black

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INSTALLATION:

A. Provide as indicated and detailed on the drawings, and as per manufacturer's standard printed specifications, instructions and recommendations.

B. Provide completed shop drawing and manufactured cut sheets on all manufactured items.

END OF SECTION 107500

SECTION 11 30 13 - APPLIANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Kitchenette appliances.

1.2 RELATED REQUIREMENTS

A. Section 22 10 00 - Plumbing Piping and Specialties: Plumbing connections for appliances.

B. Section 26 05 20 - Conductors and Cables - 600V and Below: Electrical connections for appliances.

1.3 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

B. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

1.6 WARRANTY

A. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.

B. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

C. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.1 KITCHEN APPLIANCES

A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.

B. Refrigerator: Free-standing, side-by-side, and frost-free.
   1. Size: As indicated on Drawings.
   2. Exterior Finish: Stainless steel.
   3. Manufacturers:
      a. Basis of Design: GE Appliances, model as indicated on Drawings.
      b. Frigidaire Home Products.

c. Whirlpool Corp.

C. Microwave: Built-In with Trim Kit.
1. Size: As indicated on Drawings.
2. Exterior Finish: Stainless Steel.
3. Manufacturers:
a. Basis of Design: Frigidaire Home Products, model as indicated on Drawings.
b. GE Appliances.
c. Whirlpool Corp.

D. Dishwasher: Undercounter, Built-in.
1. Size: As indicated on Drawings.
2. Finish: Custom Panels matching adjacent cabinetry.
3. Manufacturers:
a. Basis of Design: Bosch, model as indicated on Drawings.
b. Frigidaire Home Products.
c. GE Appliances.
d. Whirlpool Corp.

E. Coffee Machine: Countertop.
1. Size: As indicated on Drawings.
2. Finish: Black.
3. Manufacturers:
a. Basis of Design: Cafection, model as indicated on Drawings.
b. Other approved manufacturers by architect which met design criteria of basis of design unit.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor built-in equipment in place.

3.3 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.4 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION

SECTION 115213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Projection screens are Owner Furnished, Owner Installed (OFOI).

B. Provide and coordinate infrastructure required to support Owner-furnished projection screens as indicated on the Drawings.

1.2 RELATED DOCUMENT

A. The specifications sections "General Conditions", "Special Requirements" and "General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

B. Drawings and Division 00 and 01 Specification Sections, apply to this Section.

1.3 RELATED SECTIONS

A. Division 5 - Metal Fabrications: Suspension systems for projection screens.

B. Section 064000 – Architectural Woodwork

C. Section 090000 – Finish List

D. Section 092100 – Plaster and Gypsum Board Assemblies

E. Section 092226 – Suspension Systems

F. Section 092613 – Gypsum Veneer Plastering

G. Section 095000 – Ceilings

H. Division 26 for electrical wiring, connections, and installation of remote-control switches for electrically operated projection screens.

1.4 REFERENCES

A. NFPA 70 - National Electrical Code

B. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films

C. GREENGUARD Environmental Institute Gold

D. US Green Building Council

E. International Code Council (ICC):
   1. International Building Code.

F. Society of Motion Picture and Television Engineers (SMPTE):
   1. SMPTE RP 94-2000, Gain Determination of Front Projection Screens.

G. Underwriters Laboratories Inc. (UL).

1.5 SUBMITTALS

A. Submit coordination information necessary to verify structural support, ceiling openings, electrical power, control pathways, clearances, and other infrastructure required for Owner-furnished projection screens.

1.6 QUALITY ASSURANCE

A. Owner-furnished motorized projection screens shall be listed and labeled by a nationally recognized testing laboratory for the intended application.

1.7 DELIVERY, STORAGE AND HANDLING

A. Owner's installer store projection screens in a dry, ventilated area, protected from exposure to harmful weather conditions, at a temperature less than 80 degrees F (27 degrees C).

B. Owner's installer shall coordinate delivery of projection screens until building is enclosed, other construction within spaces where screens will be installed is substantially complete, and installation of screens is ready to begin.

C. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.

D. Protect screens from damage during delivery, handling, storage, and installation.

1.8 PROJECT AMBIENT CONDITIONS

A. Project Location: Perform projection screen installation under environmental conditions recommended by the manufacturer.

1.9 COORDINATION

A. Coordinate projection screen locations and infrastructure requirements with the Owner-furnished equipment and approved architectural construction.

B. Coordinate structural support, ceiling openings, electrical power, control pathways, and required clearances with related trades.

PART 2 - PRODUCTS

2.1 SCREEN TYPE A – MOTORIZED FRONT PROJECTION SCREEN

A. Infrastructure Reference Product: Da-Lite Tensioned Advantage SightLine projection screen, as indicated on the Drawings. Projection screen is OFOI and is identified for infrastructure coordination only.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate projection screen locations and required infrastructure with ceiling construction and related components penetrating or above ceilings, including lighting fixtures, mechanical equipment, ductwork, and fire-suppression systems.

B. Coordinate requirements for blocking, structural supports, and bracing to ensure adequate means for installation of screens.

C. Coordinate requirements for power supply, conduit, and wiring required for projection screen motors and controls.

D. Coordinate installation of recessed mounted screens with construction of suspended acoustical panel ceilings. Where acoustical ceiling panels are to be adhered to screen case closure, provide and coordinate required tolerances and weight restrictions.

3.2 INSTALLATION

A. Projection screens and housings are Owner Furnished, Owner Installed (OFOI).

B. Owner’s installer shall install projection screens and controls at locations and heights indicated on the Drawings.
   1. Adjust the UP-limit switch to the fully retracted position in accordance with manufacturer's instructions.
   2. Adjust the DOWN limit switch such that the bottom of the viewing surface is at the height indicated on drawings.

C. Owner's installer shall install projection screens in accordance with manufacturer’s written instructions and approved shop drawings.

D. Owner's installer shall install screen cases securely to supporting construction and in proper relationship to adjoining construction. Install screens level and plumb, with viewing surfaces flat when fully extended.

E. Owner’s installer shall adjust tab-tensioning system, where provided, in accordance with manufacturer’s instructions to provide a flat viewing surface.

3.3 TESTING AND DEMONSTRATION

A. Owner’s installer shall test motorized projection screens to verify proper operation of screens, controls, limit switches, and other operating components. Verify screens are level and viewing surfaces are plumb and flat when extended. Correct deficiencies.

B. Owner's installer shall demonstrate operation of screen to Owner's designated representatives.

3.4 PROTECTING

A. Owner’s installer shall protect installed projection screens from damage during subsequent construction operations.

END OF SECTION

SECTION 115223 – PROJECTOR LIFTS

PART 1 - GENERAL

1.1 SUMMARY

A. Specification includes: Motorized Projector Lifts

1.2 RELATED DOCUMENT

A. The specifications sections "General Conditions", "Special Requirements" and "General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

B. Drawings and Division 00 and 01 Specification Sections, apply to this Section.

1.3 RELATED SECTIONS

A. Section 090000 – Finish List

B. Section 092100 – Plaster and Gypsum Board Assemblies

C. Section 092226 – Suspension Systems

D. Section 092613 – Gypsum Veneer Plastering

E. Section 095000 – Ceilings

F. Division 26 for electrical power, wiring, connections, and installation of remote-control switches for motorized projector lifts.

1.4 REFERENCES

A. NFPA 70 - National Electrical Code

B. International Code Council (ICC): International Building Code.

C. Underwriters Laboratories Inc. (UL).

1.5 SUBMITTALS

A. Submit in accordance with Section 01 Submittal Procedures:
   1. List of proposed products and product data.
   2. Shop drawings shall indicate lift dimensions, required clearances, structural attachment, ceiling opening, projector mounting, service position, show position, power requirements, control connections, cable management, and ceiling closure requirements.
   3. Manufacturer's installation and maintenance instructions.
   4. Samples: Provide finish samples for exposed ceiling closure components for Architect's selection.

1.6 QUALITY ASSURANCE

A. Source limitation: Obtain projector lifts from single manufacturer as a complete unit including necessary mounting hardware, motor, controls, limit switches, and accessories.

B. Motorized projector lift assemblies shall be listed and labeled by a nationally recognized testing laboratory for the intended application.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver motorized projector lifts in manufacturer’s original, unopened, undamaged containers with identification labels intact.

B. Inspect motorized projector lifts for freight damage, concealed or otherwise, upon delivery to project site. Report damage to freight carrier immediately for replacement of motorized projector lifts.

C. Store motorized projector lifts in resealed manufacturer's original containers.

1.8 COORDINATION

A. Coordinate work with installation of ceilings, walls, electric service power characteristics, and location.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Base specification
   1. Draper, Inc., 411 S. Pearl P. O. Box 425; Spiceland, IN 47385-0425. ASD. Toll Free Tel: 800-238-7999; Tel: 765-987-7999; Fax: 866-637-5611; www.draperinc.com.

B. Other Acceptable manufacturer
   1. Display Devices; 21075 Westgate Road, Golden, CO 80403; 303-412-0399; https://www.displaydevices.com/

C. Substitutions
   1. Requests for substitutions will be considered in accordance with provisions of Section 002600.
      a. Contractor can provide substitution requests for consideration. Request shall include a complete description of proposed substitution including drawings, performance and test data and other information necessary to demonstrate that the substitution will meet all intentions of this Specification or required for a complete evaluation.
      b. Contractor shall assume and bear all responsibility for coordinating and performing related changes in the work necessitated by such substitution.
      c. Burden of proof of merit of proposed substitution is upon Contractor.
      d. Proposed substitutions shall demonstrate equivalent load capacity, travel, control functionality, service access, and compatibility with available structural and ceiling space indicated on the Drawings.

2.2 MOTORIZED SCISSOR PROJECTOR LIFT

A. Electrically Operated, Scissor Lift: Electrically operated, tight stacking scissor type, projector lift for lowering and retracting projector from ceiling storage location to position for show or service. Scissor Lift Model SLX21 as manufactured by Draper, Inc. to include controls, mounting hardware, wiring, and other components required for complete operation. If installed in a non-plenum space, or if installed in a plenum space with Environmental Airspace Housing and Closure, the entire unit is US UL Listed to UL 2442 and Canada UL Listed to CSA C22.2 No. 60065-03.

   1. Basis-of-Design Product: Draper Scissor Lift SLX21.

      a. Limit Switches: Provide factory-set show position 36 inches (914 mm) below stored position and field adjustable to suit final projection geometry indicated on Drawings.
      b. Maximum Lift Extension and Capacity:

         1) SLX21: Extension 21 feet 3 inches (648 cm), Capacity 350 LBS.

      c. Approximate Travel Speed: 90 inches (2286 mm) in 60 seconds.
      d. Voltage: 120V AC, 60 Hz.

B. Operating Mechanism: Three sets of steel stabilizing scissors positioned on sides and rear of operating pan, and two 3/16-inch (5 mm) diameter aircraft cables with 4,200 foot-pounds tensile strength per cable. Provide reversible, thermally protected, lifetime-lubricated motor and fail-safe operating mechanism.

C. Safety Belt: Provide lift with fail-safe inertial safety belt system.

D. Operating Pan: Manufacturer's standard steel operating pan suitable for the projector indicated in the AV equipment schedule, with factory powder-coat finish.

1. Coordinate color/finish with Owner.

2. Projector Attachment: Mount projector securely to operating pan using mounting hardware compatible with projector indicated in AV equipment schedule.

E. Cable Management System: Provide lift with manufacturer's cable management system. Provide projector power cable and accommodate AV/control cabling indicated on the Drawings, including RS-232 control and HDMI cabling.

F. Ceiling closure: Provide manufacturer's ceiling closure panel compatible with adjacent ceiling construction and coordinated with Architect's finish requirements. Provide metal trim ring at ceiling opening.

G. Environmental Airspace Housing: Provide where required for installation within environmental airspace/return-air plenum.

H. Provide lift with manufacturer-standard switched receptacle for projector power, compatible with specified 120V lift configuration.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of projector lifts with ceiling construction and related components penetrating or above ceilings such as lighting fixtures, mechanical equipment, ductwork, and fire-suppression system.

B. Coordinate requirements for blocking, structural supports, bracing, and ceiling openings to ensure adequate means for installation of lifts.

C. Coordinate requirements for power supply conduit, and wiring required for projector lifts and controls.

D. Coordinate installation of recessed projector lifts with suspended acoustical panel ceilings and/or gypsum ceilings specified in Division 09. Coordinate ceiling closure, required tolerances, finish, and weight restrictions with adjacent ceiling construction.

3.2 INSTALLATION

A. Install projector lifts at locations and heights indicated on Drawings and in accordance with manufacturer's written instructions and approved shop drawings.

B. Install lifts level, securely attached to building structure, with operating path unobstructed.

C. Coordinate projector mounting, ceiling closure, power, control connections, and AV cabling.

D. Adjust show and service positions as indicated on Drawings.

E. Adjust service position to provide maintenance access at the elevation indicated on Drawings.

F. Test motorized projector lifts to verify that lifts, controls, limit switches, closures, and other operating components are functional. Correct deficiencies.

G. Demonstrate operation of lifts to Owner's designated representatives.

3.3 PROTECTING

A. Protect projection lifts after installation from damage from construction operations. If damage occurs, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 12 22 16 - DRAPERY TRACK AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Extruded aluminum track.

B. Nylon carriers, cords, and accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordinate location and installation of concealed blocking for support of tracks.

1.3 SUBMITTALS

A. Product Data: Provide track profiles, shapes, and finishes available.

B. Shop Drawings: Indicate end track location, width of window opening, location of blocking for anchors, appurtenances and interferences, adjacent construction, operating hardware, and support bracket details.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Carriers: Quantity equal to 5 percent of those installed.
   2. Extra Control Cords/Wands: Two of each type installed.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Drapery Track:
   1. Kirsch, Inc; Architrac: www.kirsch.com/#sle.
   2. Substitutions: See Section 01 25 13 Product Substitution Procedures

2.2 COMPONENTS

A. Tracks: Extruded aluminum, side stacking operating traverse rods, regular duty channel track.

B. Track Brackets: Formed steel ceiling type, for surface mounted installation, with screws and inserts for attachment.

C. Carriers: Nylon roller 3 per foot, buttmaster type.

D. Control Wand: Clear Arcrylic; round shape; non-removable type; 72 inch length.

2.3 TRACK FINISHES

A. Exposed Track Surfaces: Baked enamel, white.

2.4 DRAPERY FABRICATION

A. Fabric:
   1. Manufacturer, pattern, color, etc: As indicated in Drawings
   2. Height: Full height of window
   3. Fullness: 120%
   4. Style: Ripplefold
   5. Draw: One-way baton draw, buttmaster
   6. Hems:
      a. Bottom: Euro hem, bead weighted
      b. side: 3 inch return on stacking side

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Verify field dimensions, structural support and pocket size for compliance with shop drawing

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Adjacent finishes must be complete and dry prior to installation of drapery.

E. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

A. Install drapery tracks in accordance with manufacturer's instructions.

B. Mount track support brackets on solid backing. Where mounting location does not align with solid backing, provide expanding anchors for each screw hole location.

3.4 ADJUSTING

A. Adjust drapery hardware for smooth operation.

3.5 CLEANING & PROTECTION

A. Steam and dress drapery fabric.

B. Protect installed draperies and hardware from soiling, physical damage or staining by subsequent construction trades.

C. Do not permit construction activities at or near finished draperies.

D. Contractor to clean, repair or replace any stained, torn or wrinkled draperies prior to substantial completion.

END OF SECTION

SECTION 12 24 00 - WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior manual roller shades.

B. Interior motorized roller shades.

C. Motor controls.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
   2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
   1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.

B. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
   1. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

C. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

D. Selection Samples: Motorized Shades: Include finish selections for controls.

E. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

F. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; to be provided to Owner for project close out.

H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience with shading systems of similar size and type.

1.5 MOCK-UP

A. Mock-Up: Provide full size mock-up of motorized window shade system complete with selected shade fabrics.
   1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
   2. Full-sized mock-up may become part of the final installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.7 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. MechoShade Systems LLC; Mecho/5 System: www.mechoshade.com/#sle.

B. Interior Motorized Roller Shades, Motors and Motor Controls:
   1. MechoShade Systems LLC; Electroshade: www.mechoshade.com/#sle.

C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.
   3. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
      a. Comply with NFPA 70.
      b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.

c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.

B. Roller Shades Type WS2 - Basis of Design: MechoShade Systems LLC; Mecho/5 System; www.mechoshade.com/#sle.
1. Description: Single roller, manually operated fabric window shades.
   a. Drop Position: Regular roll.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
3. Roller Tubes:
   a. Material: Extruded aluminum.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
   d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
   a. Provide a permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
   b. Brake must withstand minimum pull force of 50 pounds in the stopped position.
   c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 pound minimum breaking strength. Provide upper and lower limit stops.
   a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
7. Managed Lift: Required lifting force of 3 pounds to a maximum of 8.5 pounds for single-band or multi-band shades up to 5 bands and a maximum of 30 pounds hanging weight.
8. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
      1) Color: Gray.
      2) Profile: Square.

C. Roller Shades Type WS1 - Basis of Design: MechoShade Systems LLC; ElectroShade with WhisperShade IQ2 EDU, line voltage (120 VAC); www.mechoshade.com/#sle.
1. Description: Two Single roller, motor-operated fabric window shade systems complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Drop Position: LIght-Filtering - Room-side: Regular roll.
   b. Drop Position: Room-Darkening, glass-side: Reverse roll.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   a. Two systems stacked horizontally in one pocket
      1) Light-Filtering Fabric: Room-side of opening.
      2) Room-Darkening Fabric: Glass-side of opening.
   b. Shades 215" AF: Shall require security brackets with catch pin for engagement.
   c. Multiple Shade Operation: Provide hardware as necessary to operate more than one shade using a single motor.
3. Roller Tubes:
   a. Material: Extruded aluminum.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.

c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.

4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Intelligent Encoded Electronic Drive System:
   a. Line Voltage EDU (120 VAC):
      1) Audible Noise: 46 dBA or less measured 3 feet from the motor unit, depending on motor torque.
   b. Modes of Operation:
      1) Uniform Mode: Allows for shades to move only to defined intermediate stop positions in order to maintain aesthetic uniformity.
      2) Normal Mode: Allows for shades to move to defined intermediate stop positions plus any position between defined upper and lower limits.
      3) Maintenance Mode: Prevents shade from moving to newly commanded positions via dry contact or network control commands until EDU has been serviced and/or Maintenance Mode has been cleared/disabled.
   c. Control Methods: Support both local isolated dry contact input and network control.
      1) Local isolated dry contact inputs support local switch control and third-party system integration without separate interface.
      2) Bidirectional network communication enables commanding the operation of large groups of shades over a common backbone.
      3) Provide a minimum of three customizable preset positions accessible over the local dry contact control inputs and over the network connection.
      4) Provide a minimum of 32 customizable preset positions (including the three local switch presets) accessible via network commands.

2.3 SHADE FABRIC

A. Fabric for Light-Filtering Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Manufacturers:
      a. MechoShade Systems LLC; Soho - 1600 Series (3% open): www.mechoshade.com/#sle.
   2. Roll Width: 126 inches.
   3. Color: As indicated in drawings.

B. Fabric for Room-Darkening Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Manufacturuers:
      a. MechoShade Systems LLC; Acoustiveil Dimout - 0890 Series (0-1% open): www.mechoshade.com/#sle.
   2. Roll Width: 86 inches
   3. Color: As indicated in drawings.
   4. Fabrication: material cannot be railroaded

2.4 MOTOR CONTROLS

A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

B. Provide all components and connections necessary to interface with other systems as indicated.

C. Digital Network Controls:
   1. Intelligent Motors and Devices: Identifiable over network without separate interface.

2. Provide suitable interface modules as indicated or as required for connection to standard (nonintelligent) motors and devices.
3. Capable of reprogrammed control without requiring wiring modifications.
4. Capable of assigning shade motors to shade groups/sub-groups.
5. Capable of storing programmable open and close limits and minimum of three intermediate preset stop positions for each shade.
6. Capable of aligning adjacent shades within accuracy of plus/minus 0.25 inch.
7. Provide 10 year nonvolatile power failure memory for system configuration settings.
8. Basis of Design: MechoShade Systems LLC; MechoNet: www.mechoshade.com/#sle.
   a. Low-voltage network utilizes standard Category 5/6 UTP cable; maximum of 4,000 feet, 250 nodes.
   b. Network Interface Components:
      1) MechoNet Network Interface; MNI Series: Four configurable motor/EDU ports (models available for RJ45 or terminal block wiring); four configurable switch ports; one infrared (IR) remote control port; one configurable serial port for RS232/RS485 communication.
      2) IQ2 Dual Splitter: Two motor/EDU ports; two switch ports.
      3) IQ/MLC2 Motor Group Controller: Four ports for line-voltage standard (nonintelligent) motors (120 or 230 VAC; 600 W, 1/4 HP maximum).

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 SYSTEM STARTUP

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.5 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.6 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

B. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.7 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 36 00 - COUNTERTOPS AND WINDOW SILLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Wall-hung counters tops.

C. window sills

1.2 SUBMITTALS

A. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

B. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

C. Installation Instructions: Manufacturer's installation instructions and recommendations.

D. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than five years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.5 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
   1. In the absence of written recommendations by the manufacturer do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants for the previous 72 hours as well as the remainder of the construction period.

B. Verify dimensions of adjacent construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 PRODUCTS

2.1 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   1. If the Contract Documents contain requirements that are more stringent than the referenced quality standard, comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Porcelain Slab Countertops: Gauged porcelain slabs bonded to substrate after installation of substrate on cabinet.
   1. Gauged Porcelain Slab: ANSI A137.3 standard grade.
      a. Manufacturers:
         1) As indicated on drawings
         2) no substitutions
      b. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
      c. Size: As indicated on drawings
      d. Thickness: 12mm
      e. Surface Finish: Glossy.
      f. Color(s): As indicated on drawings.
      g. Edge: Mitered
   2. Large and Heavy Tile (LHT) Mortar: Materials and installation as specified in Section 09 30 00.

C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      b. Manufacturer and Finish on Exposed Surfaces: As indicated on Drawings.
      c. Color and Pattern: As indicated on drawings.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.

D. Natural Quartz: Sheet or slab of natural quartz over continuous substrate.
   1. Flat Sheet Thickness: 3cm, minimum.
   2. Natural Quartz, Slabs: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
      a. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Manufacturer and Finish on Exposed Surfaces: As indicated on Drawings.
      d. Color and Pattern: As indicated on drawings.
   3. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.

2.2 WINDOW SILLS

A. Solid Surface Window Sills: Solid surfacing sheet or plastic resin over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch minimum.

2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
   a. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
   b. Manufacturers: As indicated on drawings.
   c. Color and Pattern: As indicated on drawings.
   d. Finish on Exposed Surfaces: Polished, gloss rating of 55 to 80.
   e. Edge Profile: As indicated on Finish Material Legend.
3. Other Components Thickness1/2 inch minimum.

2.3 MATERIALS

A. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

C. Joint Sealant: Mildew-resistant silicone sealant, color as selected by Architect.

D. Grommets: Doug Mockett & Company, Inc.; MM6 Grommet Cap. Finish as selected by Architect.

E. Brush Strip: Doug Mockett & Company, Inc.; BR Brush Strip, Grey

F. Wall Mounted Countertop Brackets: Rakks / Rangine Corporation; www.rakks.com.
   1. Flush Mount: EH Inside Mount Series.
   2. Finish: To be selected from full range of maufacturuers standard finishes.

2.4 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
      a. At cutouts, seal edges of supporting substrate.

B. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

C. Wall-Mounted Counters: Provide brackets and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.

C. Tile and porcelain slab installation, see Section 09 30 00.

D. Seal joint between back splashes and vertical surfaces.

3.4 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.5 CLEANING

A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 21 05 00 – GENERAL FIRE SUPPRESSION PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes specifying the general requirements for execution of that portion of the Work defined in Division 21 of these Specifications and as indicated on the Drawings:
   1. Major items include, but are not necessarily limited to:
      a. Concrete foundations and support steel.
      b. Piping, fittings and valves.
      c. Excavation and backfilling required.
      d. Fire protection systems.
      e. Labor, materials, equipment, tools, supervision and start-up services.
      f. Instructions to Owner regarding operation.
      g. Incidental and related items necessary to a complete and functionally operational installation of the Work.

B. Division of Work: In accordance with the General Conditions, Construction Manager is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the Work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the Work:
   1. General Contractor:
      a. Install access doors.
      b. Provide concrete isolation and housekeeping pads for fire suppression equipment.
      c. Provide access doors in walls and ceilings for access to fire suppression equipment.
   2. Fire Suppression Subcontractor:
      a. Furnish location, size and quantity of openings to Contractor before construction of new walls, ceilings, and floors.
      b. Furnish size and locations of concrete equipment isolation and housekeeping pads as required for this Work and as indicated on the Drawings to Contractor before slabs are poured.
      c. Furnish size and location of access doors required for this work as indicated on the Drawings to Contractor.
      d. Provide excavation and backfilling required in connection with the Work of Division 21.
      e. Provide miscellaneous structural steel required in connection with support of the Work of Division 21.
      f. Perform final cleaning of fire suppression systems and equipment.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of Division 21 shall comply with the following:
   1. ANSI: A13.1 – Standard for the Identification of Piping Systems.
   2. ASME – American Society of Mechanical Engineers: B31.9 – Building Services Piping.
   3. ASTM: A325 – Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   4. Michigan: Building Code of 2021.
   5. NFPA Standards:
      a. 13 – Installation of Sprinkler Systems.
      b. 25 – Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
      c. 1963 – Standard for Fire Hose Connections.
   6. UL:
      a. 193 – Alarm Valves for Fire Protection Service.
      b. 262 – Gate Valves for Fire Protection Service.

c. 312 – Check Valves for Fire Protection Service.
d. 668 – Hose Valves for Fire Protection Service.
e. 753 – Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service.
f. 789 – Indicator Posts for Fire Protection Services.

7. Additional References: Factory Mutual Research Corporation (FM).

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. System layout and design responsibility are included as Work of this Section:
1. Details of construction, quantities, components and accessories indicated on the Drawings and in the specifications are minimum requirements.
2. Minimum design criteria are as specified herein and as indicated on the Drawings.
3. Confirm final design requirements with the authority or authorities having jurisdiction and the Owner's insuring agency.
4. Increases in system component requirements beyond these minimums that are determined by the system designer to be necessary to provide the functional intent and for a complete system shall not be a basis for increase in cost to Owner.
5. Final Design:
a. The equipment and piping sizes and selections, where indicated on the Drawings, are minimum requirements and have been determined through the application of good engineering practice and standard calculation methods based on the best information available at the time that these documents were produced. A complete layout and hydraulic analysis has not been done.
b. It is the responsibility of Contractor to verify all assumptions and design elements used as the basis of the preliminary design and to perform final calculations, sizing and selections as necessary to comply with the performance criteria specified herein and NFPA 13.

B. Construction details, components, accessories, sizes and model numbers indicated on the Drawings or in these specifications are used to indicate minimum levels of quality and coordination requirements.

C. Equipment supplied, whether as scheduled or selected from list of acceptable Manufacturers, must meet minimum requirements listed in specifications or on Drawings, be compatible with facility and intended use, and meet requirements for a functional system.

D. Drawings:
1. Are diagrammatic and indicate general arrangement of systems and work included.
2. Do not necessarily indicate every required valve, fitting, trap, thermometer, gage, duct, elbow, transition, turning vane, mounting support and access panel.
3. Shall not be scaled for measurement or installation location.
4. Shall not serve as Shop Drawings.

E. Schedules and model numbers shall not be used to:
1. Serve as final, definitive quantity requirements. Contractor shall make own count as indicated on Drawings.
2. Determine proper type or model with arrangement, mounting and accessories applicable.

F. Coordinate installation work of Division 21 with work of other trades to provide a complete and functional system. Generally, the location of ductwork, sanitary, storm and vent piping take precedence over fire protection and HVAC piping, electrical conduit and cable trays.

1.5 PRODUCT UNLOADING AND HANDLING

A. Unload equipment and materials required for completion of the Work.

B. Handle and store equipment and materials carefully to prevent damage. Method of rigging and handling shall be subject to the approval of an authorized representative of the equipment Manufacturer whose equipment is being handled.

1.6 MAINTENANCE

A. Special Tools: Where special tools are required for operation, furnish these to Owner.

B. Loose and Detachable Parts:
   1. Retain loose and small detachable parts of the apparatus and equipment furnished until the completion of the Work.
   2. Turn over these parts to Owner.

C. Construction Strainers:
   1. Remove after flushing and cleaning and prior to commencement of TAB.
   2. Attach removed construction strainer to piping where removed as proof of removal.

PART 2 - PRODUCTS

2.1 FABRICATIONS

A. Miscellaneous Structural Steel:
   1. Comply with the requirements of Division 05 Section “Metal Fabrications,” where applicable.
   2. Structural steel work shall be done in accordance with the AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings, except that allowable stresses shall be reduced 25%.
   3. Where required, high strength structural steel bolting conforming to ASTM Specification A325 and assembled to AISC "Specifications for Assembly of Structural Joints. Using High Strength Steel Bolts" or welding shall be used in place of rivets.
   4. Connections shall be properly designed for the type of connection and the loads to be carried, and shall be subject to Engineer's or Owner's approval.
   5. Welding shall be done by operators who have been previously qualified by tests as prescribed in the American Welding Society "Standard Qualification Procedure" to perform the type of work required.
   6. Welding techniques shall conform to the American Welding Society "Code for Arc and Gas Welding in Building Construction", Section 4, Workmanship.
   7. Finished members shall be true to line and free from twist, bends and open joints.

B. Material installed in a ceiling plenum shall be either noncombustible or have a maximum flame spread of 25 and a maximum smoke developed rating of 50.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Character of Work: Installation shall be executed in a workmanlike manner and shall present a neat mechanical appearance when completed.

B. Laying Out of Work:
   1. Layout piping, equipment and components in accordance with the Contract Documents and the Manufacturer’s recommended practice, including provision of adequate space for maintenance. Review layout with Engineer prior to installation.
   2. Check drawings of other trades to verify spaces in which work will be installed. Maintain maximum head room and space conditions at all points. Where head room or space conditions appear inadequate, notify Engineer before proceeding with installation.
   3. If directed by Engineer, Contractor shall make reasonable modifications in the layout as required to permit proper execution of the Work and to prevent conflict with work of other trades.
   4. Work shall be installed so as to be ready for operation, maintenance and repair. Minor deviations from Drawings may be made to accomplish this. Changes shall not be made without approval of Engineer.

3.2 EXCAVATING AND BACKFILLING

A. Comply with the requirements of Division 31 Section “Excavation and Fill for Utilities.”

B. Backfill shall be MDOT Class II sand backfill. The use of clay, stone, rocks, brickbats, cinders, or frozen sand for backfill will not be permitted.

C. Backfill and fill below structures and pavements shall be compacted to 95% density as determined by ASTM modified proctor.

D. Pipe Bedding Material Shall:
   1. Conform with Manufacturer's recommendations.
   2. Be MDOT Class II modified to maximum size of 3/8 inches and compacted to 95% density as determined by ASTM modified proctor; or pea gravel with best compaction possible to provide firm continuous support.
   3. Run full width of trench from minimum 4 inches below pipe to 12 inches above pipe.

3.3 PIPE FITTINGS

A. Provide insulating couplings or unions where dissimilar materials are joined.

B. Provide unions at valves and at equipment for making repairs.

3.4 PAINTING

A. Paint exposed, non-insulated piping in accordance with the requirements of Division 09 – Finishes.

B. Provide labels as specified below. Comply with OSHA “Safety Color Code for Marking Physical Hazards” and ANSI A13.1 for pipe labels and colors.

C. Valves, Fittings, and Supports:
   1. Paint valves and fittings the same base color as the pipe they adjoin.
   2. Paint floor stands the same base color as the pipe they adjoin.
   3. Paint wall brackets and pipe hangers the same base color as the wall or ceiling they adjoin, or gray, if wall or ceiling is not painted.

3.5 CODING AND TAGGING

A. Piping:
   1. Applied to new piping after installation, insulation, and final painting.
   2. Conform to Owner’s existing standards or conventions.
   3. Markings:
      a. Painted on, 1-inch high black letters.
      b. Color coded band, conforming to ANSI A13.1.
      c. Directional arrow.
   4. Place markers at 20-foot centers with at least 1 in each room, and at each change in direction.
   5. Plastic coated "Set Mark-Snap-Around" pipe markers manufactured by Seton Name Plate Corp., New Haven, Connecticut; or approved equal, may be used in lieu of painted markers and bands.

B. Valves:
   1. Provide brass or minimum 1/16-inch thick laminated plastic tags indicating assigned valve number on valves.
   2. Furnish schedule(s) of tagged valves with number, location and purpose of each valve.
   3. Place a copy of each schedule:
      a. In the Maintenance Instructions.
      b. In a string tie envelope labeled "Valve Schedule" and mount on the wall in Mechanical Room.

C. Where valves are located above the ceilings, a cadmium plated screw or such marking as designed by Engineer shall be located in the ceiling tile directly below the device.

3.6 START-UP

A. Comply with the requirements of Division 01 Section “Starting and Adjusting.”

3.7 ADJUSTING

A. Adjust and align equipment for smooth operation:
   1. Plumb true and with parts in proper position and alignment.
   2. Rotating parts shall turn freely and in the correct direction.
   3. Flexible couplings shall be checked for alignment subject to Owner's approval.
   4. Follow Manufacturer's instructions.

B. The work of installation shall be executed in conformity with the best practice, so as to contribute to efficiency of operation, minimum noise or vibration, minimum maintenance, accessibility and sightlines.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:
   1. Provide when required by individual Section.
   2. Provide the following services except where indicated otherwise in individual Sections:
      a. Inspect, check and approve system installation.
      b. Supervise system start-up.
      c. Provide written report indicating that system:
         1) Has been properly installed and lubricated.
         2) Is in accurate alignment.
         3) Is free from undue stress imposed by connecting lines or anchor bolts.
         4) Has been satisfactorily operated under full load conditions.
      d. Demonstrate operation of system to Owner's personnel.
      e. Instruct Owner's personnel on operation and maintenance of system.

B. Comply with the requirements of Division 01 Section “Starting and Adjusting.”

3.9 CLEANING AND FINISHING

A. Comply with the requirements of Division 01 Section “Cleaning and Waste Management.”

B. Entire installation shall be free from surface oil and grease before work will be considered for final payment.

C. After tests have been made and the system pronounced tight:
   1. Clean piping and equipment.
   2. Lubricate bearings.

D. Final cleaning includes but is not limited to the following:
   1. Equipment with Factory Finishes:
      a. Wash factory-finished equipment with mild soap and water and leave in first-class condition, entirely free of stains or streaks.
      b. Do not use abrasive materials. Touch up scratches or other violations of the factory finish paint with matching paint from the equipment Manufacturer prior to cleaning.

END OF SECTION 21 05 00

SECTION 21 05 03 – STEEL PIPE AND FITTINGS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of steel pipe and fittings.

B. Division of Work: In accordance with the General Conditions, Construction Manager is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. General Contractor: Coordinate work of this Section with other trades.
   2. Mechanical Subcontractor: All work of this Section except as listed under General Contractor.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ANSI/ASME Standards:
      a. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
      b. B16.3 – Malleable Iron Threaded Fittings, Class150 and 300.
      c. B16.4 – Cast-Iron Threaded Fittings, Class 125 and 250.
      d. B16.5 – Steel Pipe Flanges and Flanged Fittings.
      e. B16.9 – Factory-Made Wrought Steel Buttwelding Fittings.
      f. B16.11 – Forged Steel Fittings, Socket Welding and Threaded.
      g. B16.21 – Nonmetallic Flat Gasket for Pipe Flanges.
      h. B16.25 – Buttwelding Ends for Pipe, Valves, Flanges, and Fittings.
      i. B18.2.1 – Square and Hex Bolts and Screws, Inch Series.
      j. B18.2.2 – Square and Hex Nuts.
      k. B31.1 – Power Piping.
      l. B31.9 – Building Services Piping.
      m. B36.10M – Wrought Steel Pipe.
   2. American Society of Mechanical Engineers (ASME) publications:
      a. Boiler and Pressure Vessel Code.
      b. Power Boiler Code.
      c. Heating Boiler Code.
   3. ASTM Standards:
      a. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      b. A105 – Forgings, Carbon Steel, for Piping Components.
      c. A106 – Seamless Carbon Steel Pipe for High-Temperature Service.
      d. A126 – Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      e. A135 – Specification for Electric-Resistance-Welded Steel Pipe.
      f. A181 – Forgings, Carbon Steel for General Purpose Piping.
      g. A182 – Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings and Valves for High Temperature Service.
      h. A193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
      i. A194 – Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
      j. A197 – Cupola Malleable Iron.
      k. A234 – Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
      l. A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

m. A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile.
n. A312 – Seamless and Welded Austenitic Stainless Steel Pipe.
o. A395 – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
p. A536 – Ductile Iron Castings.
q. A795 – Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

1.4 SUBMITTALS

A. Submit Manufacturer's Literature: For steel pipe and fittings. Include Manufacturer name, Manufacturer location, dimensions, and details of construction and installation.

B. Submit Fire Protection Shop Drawings: Include grooved joint couplings and fittings and product submittals, specifically identified with the applicable manufacturer style number.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed Shop Drawings.
3. Provide a grooved coupling manufacturer’s factory trained field representative 1 day of on-site training for Contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.

B. Labeling: Piping materials shall bear the label, stamp or other marking of all specified standards and testing compliance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
1. Except as herein specified or as indicated on the Drawings, all materials shall be in accordance with the Piping Systems Schedule in Part 3 of the appropriate applicable specification section.
2. Pipe 6'-0" and longer shall be permanently marked with the following information:
a. Manufacturer's name.
b. Pressure rating.
c. Size.
3. All pipe joints shall be welded or grooved for pipe sizes 2-1/2 inches and larger.

B. Black Steel Pipe:
1. Black steel pipe shall be welded or seamless carbon steel, as specified for the type of service.
2. Welded black steel pipe shall meet the requirements of ASTM A53 or A106, and shall be Type F continuous-weld furnace butt-welding (CW), or Type E electric resistance welded (ERW) Grade B.
3. Seamless black steel pipe shall meet the requirements of ASTM A53 or A106, Type S seamless, Grade A or B.

C. Buried Piping:
1. Wrap with a pressure sensitive, adhesive backed, polyvinyl chloride or polyethylene tape:
a. Spirally wrap straight pipe with 0.020-inch thick tape with minimum overlap of 1/2-inch.
b. Spirally wrap 2 layers of 0.010 thick tape with minimum overlap of 1/2-inch.
c. Manufacturers: 3M Company “Scotchwrap”; or approved equal.
2. Steel pipe with a factory applied polyethylene plastic coating such as Energy Coatings Company, “Pritec” may be used in lieu of wrapping specified above.

2.2 FITTINGS

A. Unless specifically noted otherwise, all fittings shall be of the same material or finish material as the pipe in which they are used.
   1. Cast iron or ductile iron fittings used on galvanized steel pipe shall be galvanized.

B. Unions:
   1. Pipe Sizes 2 Inches and Smaller :
      a. Forged steel with ground joint.
      b. Properly fitted for design temperature and pressure.
      c. 2000 pound rated equal to Crane No. 250H or 251H.
      d. 3000 pound rated equal to Crane No. 252H.
   2. Pipe Sizes 2-1/2 Inches and Greater: Use companion flanges where unions are required.

C. Tapped Bosses:
   1. Permitted in pipes and fittings.
   2. 1-1/2-inch maximum hole size.
   3. Boss Construction:
      a. Weld material built up to a thickness 50% greater than required threads.
      b. Forged bosses as approved by Engineer.
      c. 300 pound rated half couplings welded to pipe permitted for instrument connections 3/4-inch or smaller.

D. Screwed Fittings:
   1. Cast iron in accordance with ASME B16.4.
   2. Ductile iron in accordance with ASTM A395.

E. Welding Fittings:
   1. Meet ASTM A234 symbol WPA or WPB.
   2. The A or B grade shall conform to the grade of pipe used with the fittings.
   3. Dimensional standards shall conform to ASME B16.9.

F. Flanges:
   1. General:
      a. Welding neck or slip-on type with raised face.
      b. Conforming to ANSI B16.5.
      c. Class 150 and 300 conforming to ASTM A181, Grade I.
      d. Class 600 and 900 conforming to ASTM A105, Grade II.
   2. Use threaded or socket weld type for piping smaller than 2-1/2 inches.
   3. Use flat face steel flanges when matching cast iron companion flanges.

G. Flange Gaskets:
   1. Nonasbestos compressed material conforming to ASME B16.21 and suitable for 600 degrees F service.
   2. Ring type, 1/16-inch thickness.
   3. Spiral wound stainless steel for service over 300 psi.
   4. Use full face gaskets with flat face flanges.

H. Bolting Material:
   1. General:
      a. Carbon steel, square-head bolts and Grade 2H hex nuts.
      b. Bolt length shall be sufficient to extend completely through nut with maximum 3/8-inch projection.
      c. Dimensions conforming to ASME B18.2 (bolts) and ASTM A194 (nuts).
   2. Bolts:
      a. For service below 250 psig/450 degrees F, use Grade B conforming to ASTM A307.
      b. For service at or above 250 psig/450 degrees F, use Grade B7 conforming to ASTM A193.

I. Socket Welding Fittings: All forged steel socket-welding fittings shall conform to ASME Standard B16.11 ASTM A105 Gr. II, equal to Crane 3,000-pound forged fittings.

2.3 GROOVED COUPLING SYSTEMS

A. Manufacturers:
   1. Anvil.
   2. Victaulic.
   3. Grinnell.

B. General:
   1. All grooved piping materials shall conform with the specifications governing the systems or application for which they are used.
   2. All couplings and fittings shall be finished with hot-dip galvanizing or alkyd enamel paint, unless copper.
   3. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
   4. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

C. Pipe and Tubing:
   1. Standard Weight Steel Pipe:
      a. Comply with the requirements of this Section.
      b. ASTM Schedule 40, A53 black steel or hot-dipped zinc-coated and seamless.
   2. Light Wall Steel Pipe:
      a. Comply with the requirements of this Section.
      b. Schedule 10, 20 or 30 as allowed in Application Section, ASTM A53 black steel or hot-dipped zinc-coated.

D. Couplings:
   1. Housing:
      a. Standard Weight and Light Wall Steel Pipe: Ductile iron, ASTM A536.
   2. Style:
      a. Standard Weight and Light Wall Steel Pipe:
         1) Rigid style.
         2) Victaulic “Zero-Flex” style 07
         3) Victaulic “Installation Ready” “FireLock” EZ Style 009N UL, FM 109, and 107N UL.
   3. Gasket:
      a. Water Service: EDPM.
   4. Bolts – Nuts:
      a. Track bolts with 110,000 psi tensile strength.
      b. Heavy hex nuts.
      c. Zinc electroplated carbon steel.

E. Fittings:
   1. Steel, ductile iron.
   2. Grooves or shoulders compatible with system couplings.
   3. Victaulic “Installation Ready” fittings.
      a. Groove: IGS “Innovative Groove System. Victaulic RG2100, with IGS Confirmation Gauge. System shall be UL listed for a working pressure of 300 psi, and FM approved for working pressure of 365 psi.
   4. Segmentally welded fittings not acceptable.
   5. Clamp-on mechanical not acceptable.

F. Valves:
   1. Refer to Division 21 Section “Water Based Fire Suppression Systems” or specification section governing the system or application for which they are used.
   2. Compatible with grooved pipe coupling.

G. Strainers:
   1. Refer to Division 21 Section “Water Based Fire Suppression Systems.”
   2. Compatible with grooved pipe coupling.

PART 3 - EXECUTION

3.1 PREPARATION

A. During Freezing Weather:
   1. Protect all materials in such a manner that no harm can be done to:
      a. Installations already made.
      b. Materials and equipment on the Site.
   2. Furnish all necessary protection for such installations and equipment as may be required.

3.2 ERECTION

A. General:
   1. All Piping: Follow approved paths as indicated on the Drawings.
   2. Connect to existing lines where required, or to equipment in an approved manner.
   3. Locate Pipes, Valves and Equipment to Provide:
      a. Access for maintenance.
      b. Minimum obstruction of passageways and working space.
   4. Normally, all pipe runs shall be plumb, parallel with the building and level, except for drain slope.
   5. Be responsible for establishing and maintaining drain slope of piping in order to ensure drainage.
   6. Expansion of Piping:
      a. All pipe connections shall provide freedom of movement of the piping during expansion and contraction without springing of piping or injury to building steel or structure.
      b. Any damage to building steel or structure as a result of work installed by Contractor shall be repaired at Contractor's expense.
   7. As Piping Material is Erected:
      a. Thoroughly clean the inside of all piping.
      b. Remove foreign material such as scale, sand, weld spatter, particles and cutting chips.
   8. Provide caps or plugs in all openings at the end of each day's work and as otherwise directed for the protection of the piping. Particular attention must be given to avoid the possibility of any foreign material entering the pipes.
   9. Flanges shall be made on pipe so that the gasket surface forms an angle of 90 degrees with the pipe axis. Screwed flanges shall be made on until the pipe projects through the flanges and then the flanges must be refaced.

B. Sleeves and Holes:
   1. Contractor shall be responsible for cutting required holes and openings in floors, walls and other structures, except as noted on the Drawings. Sleeves will be placed by Contractor in all such openings, and no holes shall be cut without Owner's approval. Sleeves shall be in accordance with the standard details included in the Drawings.
   2. All holes in floors, walls, roofs, etc., where pipe lines or other materials have been removed or installed, shall be neatly and properly filled with concrete, brick or other material in accordance with the general character of the construction at the location.

C. Unions and Eccentric Fittings:
   1. Screwed unions shall not be used on pipe sizes larger than 2-inches.
   2. Unions shall be provided at each screwed valve and where their use will facilitate dismantling of the piping and as required or directed in special cases.
   3. Eccentric fittings or eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur in the main due to the reduction in pipe size.
   4. All reducing fittings used at pump inlets shall be eccentric, flush on bottom.

D. Pipe Joints:
   1. Pipe connections at all valves shall be mechanically joined unless otherwise indicated on the Drawings or reviewed by Owner or Engineer.
   2. Pipe joints which will be buried or otherwise concealed shall be welded regardless of size.
   3. Mitered joints shall not be permitted.
   4. In general, black steel 2-1/2-inch and larger shall be welded except that a flange or union shall be provided at all valves and at equipment.

5. The connections to welded 2-1/2-inch and larger pipe shall be made with a welding tee or Weld-o-let of butt, or socket type as required. Scarf welding of side connections shall not be permitted.
6. Only welding ells shall be used for changing pipe directions of welded pipe lines.

E. Pipe Welding:
1. Where welding is called for, it shall be of the fusion process and shall consist of welding by means of either the oxyacetylene or electric arc process.
2. All welding shall conform to the ASME Boiler and Pressure Vessel Code or the ANSI Code for Pressure Piping. All welders shall be qualified in accordance with ASME Standard Qualifications for Welding Procedures, Welders and Welding Operators, or Section 9 of the ASME Boiler and Pressure Vessel Code for the class of piping being welded. Submit welding qualifications for all welders on the Project when requested by Engineer.

3.3 GROOVED SYSTEMS

A. Piping shall be prepared in accordance with the latest Manufacturer's specifications or other standards applicable.

B. Light wall (Schedule 30 or lighter) steel piping and copper tubing shall be roll grooved without metal removal.

C. Standard weight (Schedule 40 or heavier) steel piping may be roll grooved or cut grooved.

D. Couplings, fittings, valves and pipe shall be assembled in accordance with latest Manufacturer's instructions.

E. Cutting, Grooving and Crimping:
1. All flexible pipe fittings including grooved, cut and plain end and all quick fittings shall be installed with a machine specifically designed for this purpose.
2. All piping to be grooved, cut and crimped shall be prepared using this specifically designed machine.

F. Mechanical joints are not allowed within walls.

G. Manufacturer's Field Service:
1. Steel Pipe and Fittings: Arrange and pay for Manufacturer's engineer to provide the installation direction for a minimum onsite time of 1 day.
2. Grooved Couplings: Arrange and pay for a Manufacturer's factory trained field representative 1 day of on-site training for Contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.

H. Submit written approval of installation.

END OF SECTION 21 05 03

SECTION 21 05 29 – HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all pipe hanging and support systems.

B. Division of Work: In accordance with the General Conditions, Construction Manager is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. General Contractor: Coordinate work of this Section with other trades.
   2. Mechanical Subcontractor: All work of this Section except as listed under General Contractor.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. MSS – Manufacturers Standardization Society:
      a. SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture.
      b. SP-69 – Pipe Hangers and Supports – Selection and Application – 1996.
      c. SP-90 – Guidelines on Terminology for Pipe Hangers and Supports.
   2. Hanger and supports for fire suppression systems shall also conform to the following standards published by the National Fire Protection Association in the National Fire Codes for fixed extinguishing equipment:
      a. NFPA-13 – Installation of Sprinkler Systems.
   3. Hangers in general are covered in NFPA-13. If the system is other than a standard water sprinkler system, the applicable NFPA Standard shall also be consulted.

1.4 DEFINITIONS

A. Pipe Restraint: Pipe supporting element which is designed to limit or direct pipe movement due to internal static pressure, gravitational forces, frictional forces from hangers, rollers, and guides, and forces from expansion compensation devices:
   1. Pipe restraints are not designed to restrain pipe movement caused by thermal expansion, shock or surge.

B. Pipe Guide: A pipe restraint designed to direct pipe movement along a single axis.

C. Pipe Anchor: A pipe restraint designed to provide a static point about which pipe movement normally occurs, by limiting the longitudinal and axial movement at that point.

D. Other Terms: As defined in MSS SP-90.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated on Drawings or in these Specifications, this Contractor shall be responsible to design and provide all pipe hangers, supports, restraints, braces, framing, etc., as required to comply with all applicable building codes, ASME B31 and MSS SP-69.

B. Comply with the requirements of Division 21 Section “Water Based Fire Suppression Systems” for pipe hangers and supports for water based fire protection piping.

1.6 SUBMITTALS

A. Manufacturer's Literature: For structural steel attachment devices, hangers and rollers. Include name of Manufacturer; model number and MSS Type, if applicable; and piping systems to be used with.

B. Submit Shop Drawings for all engineered hanger, restraints and support assemblies.

C. Upon request by Engineer, submit calculations for all engineered hanger, restraints and support assemblies.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The materials of all pipe hanging and supporting elements shall be in accordance with the latest requirements of the ASME Code for Pressure Piping B31.1 and MSS Standard Practice MSS SP-58 and MSS SP-69 except as supplemented or modified by the requirements of these Specifications.

B. The material in contact with the pipe shall be compatible with the piping material so that neither shall have a deteriorating action on the other.

C. Special Finishes and Materials:
   1. All ferrous hangers and supports used in the following areas shall be hot dip galvanized unless noted otherwise:
      a. Outside.
      b. In wet or potentially wet areas.

2.2 MANUFACTURERS

A. Elcon.

B. Anvil.

C. Bergen.

D. Erico (Formerly Michigan Hanger).

E. Hilti.

F. Lindapter.

G. PHD Manufacturing.

2.3 PIPE HANGERS AND SUPPORTS

A. Horizontal Piping Hangers: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).
   2. Yoke Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F (49 to 232 degrees C) pipes, NPS 4 to NPS 16 (DN100 to DN400), requiring up to 4 inches (100 mm) of insulation.
   3. Carbon or Alloy Steel, Double Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN20 to DN600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN15 to DN600), if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN15 to DN100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable Swivel Split or Solid Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8 (DN20 to DN200).
7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
9. Adjustable Swivel Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).
10. Split Pipe Ring With or Without Turnbuckle Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8 (DN10 to DN200).
11. Extension Hinged or 2 Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3 (DN10 to DN80).
12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30 (DN15 to DN750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

B. Supports and Rollers:
1. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast iron floor flange.
2. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast iron floor flange with U-bolt to retain pipe.
3. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion type support for pipes, NPS 2-1/2 to NPS 36 (DN65 to DN900), if vertical adjustment is required, with steel pipe base stanchion support and cast iron floor flange.
4. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN25 to DN750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
5. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN65 to DN500), from single rod if horizontal movement caused by expansion and contraction might occur.
6. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN50 to DN1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
7. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN50 to DN600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
8. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN50 to DN750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

C. Vertical Piping Clamps: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).
2. Carbon or Alloy Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500), if longer ends are required for riser clamps.

D. Hanger Rod Attachments: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 degree F (49 to 232 degree C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 degree F (49 to 232 degree C) piping installations.

2.4 HANGER RODS

A. Minimum rod diameters for rigid rod hangers shall be as shown in MSS SP-69 Table 4 (Minimum Rod Diameter for Single Rigid Rod Hangers) and as indicated in Part 3 of these Specifications.

B. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing.

C. Rod material must be compatible with hanger and comply with above. Do not field cut thread on galvanized rod.

D. Do not use perforated strap.

E. Multiple Supports:
   1. Horizontal banks of pipe may be supported on a common base member without regard to the pipe centerline elevation.
   2. In the supporting of multiple pipe runs, provisions shall be made to keep the lines in their relative lateral positions, using clamps or clips as required. Lines subject to thermal expansion shall be free to roll axially or slide.

2.5 SADDLES AND SHIELDS

A. All Piping:
   1. Saddle: MSS Type 39 (Grinnell #160-164), or Anvil Figure 162 or 165.
   2. Shield: MSS Type 40 (Grinnell #167), provide and install in accordance with Manufacturer's shield size selection tables.
   3. The contour of the saddle shall match the radius of the pipe insulation.

2.6 BUILDING ATTACHMENTS

A. As indicated on the Drawings or in the Specifications.

B. Concrete Attachments:
   1. Provide galvanized finish for all attachments used in wet or potentially wet areas.
   2. Provide stainless steel bolts and nuts in wet and potentially wet areas.
   3. Poured Concrete:
      a. Use cast-in-place inserts or bolted surface mounted attachments, at Contractor’s option.
      b. Expansion style anchors are not permitted on piping systems subject to vibration.
   4. Precast Concrete Tees:
      a. Use fittings specifically designed for attachment to stems of precast tees.
      b. Drilling is not permitted except where specifically approved by Engineer and coordinated with precast Manufacturer to miss embedded, prestressed steel strands.
   5. Precast Concrete Plank:
      a. Use toggle bolt attachment as indicated on Drawings.
      b. Alternatively, provide adhesive anchor, Hilti HY-20; or as approved.
      c. Drilling is not permitted except where specifically approved by Engineer and coordinated with precast Manufacturer to miss embedded, prestressed steel strands.

C. Horizontal Piping:
   1. Steel W, I, or S shapes: MSS Type 23 clamp with retaining clip, (Grinnell Fig. 87) up to 2-inch; MSS Type 28 (Grinnell Fig. 292) or MSS Type 21 (Grinnell Fig. 133, 134) above 2-inch.
   2. Steel Channel: MSS Type 20 universal channel clamp.
   3. Bar Joists: Steel washer plate (Grinnell Fig. 60).
   4. Concrete: See "B" above.
   5. Timber: Angle bracket and lag screws or as detailed on Drawings.
   6. Steel Z Shapes: Custom attachment required. Submit details of welded or bolted attachment to Engineer.

D. Vertical Piping:
   1. Steel Shapes: Welded brackets as approved by Engineer.
   2. Concrete: See "B" above.
   3. Timber: Ceiling hanger flange (Grinnell Fig. 128R, 153) angle brackets and lag screws, or as detailed on Drawings.

E. In the absence of a Specification for a particular type of attachment, furnish attachments comparable in type and quality to that specified above for a similar situation.

2.7 METAL FRAMING PIPE SUPPORT SYSTEMS

A. Acceptable Manufacturers:
   1. Eaton B-Line.
   2. Elcen.
   3. Super Strut, Inc.
   4. Unistrut Building Systems.

B. Provide products from one Manufacturer.

C. Channel (Standard Applications):
   1. Mild strip steel.
   2. 12 gage minimum material.
   3. Factory painted equal to Unistrut Perma-Green.
   4. Equal to Unistrut Part No. P1000.

D. Clamps and Supports:
   1. Beam clamp equal to Unistrut Part No. P2785.
   2. Pipe strap equal to Unistrut Part No. P2558.
   3. Pipe roller equal to Unistrut Part No. P2474.
   4. All items fabricated in material equal to channel specifications.

E. Clamp Nuts:
   1. Electro-galvanized stainless steel for use with stainless steel and fiberglass parts.
   2. Mild bar steel for standard applications.
   3. Class 2 American Standard threads.
   4. Equal to Unistrut Part No. P1012.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. General Requirements:
   1. The selection of pipe hangers and supports shall be based on the overall design concept of the piping system and any special requirements which may be called for in these Specifications or as indicated on the Drawings. The support systems shall provide for, and control, the free or intended movement of the piping including its movement in relation to that of the connected equipment. They shall prevent excess stress resulting from the transfer of weight being introduced into the pipe or connected equipment.
   2. The selection of hangers and supports shall be made to provide the piping system with the degree of control that its operating characteristics require.
   3. The selection of hangers or supports will take into consideration the combined weight of the supported systems, including system contents and test water.
   4. Select and install hangers and supports to allow controlled thermal and seismic movement of piping system, to permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends and similar units.
   5. The spans in MSS SP-69 Table 3 do not apply where concentrated weights, such as valves or heavy fittings, or where changes in direction of the piping occur between hangers.
   6. Select all hangers and supports rated for the maximum potential loading with pipe full.
   7. Select hangers for cold (less than 50 degrees F) piping service for installation over the insulation.

8. Where significant, vertical movement of pipe occurs at the hanger location a resilient support must be used:
   a. Selection of resilient supports shall be based on permissible load variations and effects on adjacent equipment. Support selection for typical load variations are shown on MSS SP-69 Table 2 (Spring Support Selection). Load and movement calculations shall be made for the proper selection of spring hangers.
   b. Vertical movement and load transfer from riser expansion to horizontal runs shall be given consideration when applying spring hangers.
   c. Spring cushion hangers may be used where vertical movement does not exceed 1/4-inch and where formal load and movement calculations are not required.
   d. Variable spring hangers shall be used for all other resilient support requirements except as noted in the following paragraph.
   e. Constant support hangers shall be used on piping systems where the deviation in supporting force must be limited to 6% and which cannot be accommodated by a variable spring hanger.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. General:
   1. Adjust all components as required for proper operation and required pipe slope.
   2. Double nut all support rods at hangers.
   3. Location and Routing:
      a. Install Piping as Indicated:
         1) On the Drawings.
         2) On the reviewed Shop Drawings.
      b. Secure Engineer's approval for all pipe routing changes.
   4. Coordinate with other trades for placement of concrete attachments prior to concrete pouring.
   5. Install all items in accordance with Manufacturer's instructions.

C. Support at Valves: Provide additional supports at all valves in piping 4-inch and larger.

D. Vertical Risers:
   1. Support independently from adjacent hangers on horizontal piping.
   2. Cast Iron Waste, Vent or Drainage Piping:
      a. Support at the base and at each floor level.
      b. Support spacing not to exceed 15-foot centers.
   3. Copper Piping:
      a. Support at the base and at 6-foot maximum centers for sizes 1-1/4-inch and smaller.
      b. Pipes Larger Than 1-1/4-Inch:
         1) Supported at each floor level.
         2) Not to exceed 10-foot centers.
   4. Vertical Threaded, Welded or Grooved Steel Piping:
      a. Support at the base of the riser and at every other floor.
      b. Maximum allowable unsupported piping length is 12 feet.
   5. Plastic Piping:
      a. Support at 4-foot centers maximum for sizes 1-1/2-inch or smaller.
      b. Support at the base and at 4-foot centers for all sizes larger than 1-1/2 inches.
      c. Completely encircle covering and insulating material.

E. Horizontal Runs:
   1. General:
      a. Provide adequate supports for the loads with a factor of safety of at least 5 (400 pounds minimum).
      b. Provide protective shield at all hangers and rollers supporting plastic pipe and coated pipe.

c. Support spacing not to exceed MSS SP-69 Table 3, or the requirements for seismic restraint, whichever is more stringent.
d. Hanger rod diameter shall not be less than the requirements of MSS SP-69 Table 4, or the requirements for seismic restraint, whichever is more stringent.

2. Rollers: All piping systems designed to accommodate thermal expansion movement shall be mounted on rollers.
3. Bar Joists: Attachments to bar joists shall be made to top member and at panel points.

F. Ductile Iron Piping: The size of hanger components shall be suitable for the O.D. of the pipe to be supported.

3.3 PIPE RESTRAINTS

A. Provide adequate pipe restraints for all expansion or contraction of piping due to temperature change:
1. Including, but not limited to, that indicated on the Drawings.
2. As instructed by Owner or Engineer.
3. At locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent transfer of loading and stresses to connected equipment.
4. Spacing: Unless otherwise indicated, install at ends of main pipe runs, at intermediate joints in pipe runs between expansion loops and bends.

B. Concrete work installed in connection with anchors or supports: Make with approved Portland Cement:
1. At least 5-1/2 bags per cubic yard.
2. Properly mixed with approved aggregate.
3. Attain a compression strength of not less than 3,000 psi at 28 days.

3.4 PAINTING

A. Touchup: Cleaning and touchup of painting of field welds, bolted connections and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

B. Galvanized Surfaces: Clean welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION 21 05 29

SECTION 21 05 31 – PENETRATIONS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Pipe sleeves.
   2. Flashing and sealing of all mechanical openings through weather or waterproofed walls, roofs and floors.
   3. Sealing and finishing of all mechanical openings.
   4. Provide UL rated firestopping and sealing at all new and existing pipe penetrations of fire rated walls.

B. Division of Work: In accordance with the General Conditions, Construction Manager is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. General Contractor:
      a. Locate and place all sleeved and framed openings as part of constructing the wall and floor surfaces in which the openings occur.
      b. Provide all lintels and required stiffening members for wall and floor openings.
      c. Cut roofing and install flashing for all required openings in proprietary roof membrane systems.
      d. Cut all roof deck openings and provide required framing supports.
   2. Fire Suppression Subcontractor:
      a. Advise General Contractor of quantity, location and size of all required openings.
      b. Provide all curbs, sleeves, seals, escutcheons and related materials required for finishing, sealing and waterproofing mechanical openings. Furnish all flashing and counterflashing.
      c. Arrange and pay for all openings required after wall, roof and floor construction is complete.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with ASTM D2202 – Test Method for Slump of Sealants.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all premanufactured curbs and sealing assemblies.
   1. Manufacturer's name.
   2. Model number.
   3. Details of construction and installation.
   4. Certified load-bearing data for all curbs.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pipe Seals and Boots:
1. The Pate Company.
2. Portals Plus, Inc.
3. Roof Products and Systems Corporation.
4. Thunderline Corporation.
5. Thycurb Corporation.

B. Modular Mechanical Seals:
1. Thunderline/Link-Seal.
2. As approved.

C. Backer Rod: Industrial Thermo Polymers, “Standard Backer Rod”.

D. Acoustical Sealant: Pecora, “BA-98”.

E. Expanding Resilient Foam: General Electric, “RTF762.

2.2 MATERIALS

A. Backer Rod:
1. Extruded round, closed cell, polyethylene foam.
2. Resilient, non-exuding.
3. Density: 2.0 pounds per cubic foot.
4. Tensile Strength: 50 psi.
5. Nonabsorbent to water and gasoline.
6. Suitable for use as a backing for acoustical sealant.
7. Compatible with sealant and approved by sealant Manufacturer.

B. Acoustical Sealant:
1. Nonfire-Rated Penetrations:
a. Non-drying, non-hardening and non-bleeding.
b. Laboratory tested sealant which effectively reduces airborne sound transmission through wall systems.
c. Viscosity: 350,000 to 400,000 (Brookfield No. 65, 10 RPM).
d. Aging: Firm but rubbery, good tack after 50 days conditioned at 160 degrees F.
e. Slump: 0.1 to 0.2 inches in accordance with ASTM D2202.
f. Color: Gray.
2. Fire-Rated Penetrations: Permanently flexible, approved firestop putty.

C. Packing Material for Penetrations:
1. Glass Fiber or Mineral Fiber:
a. Noncombustible.
b. Resistant to water, mildew, and vermin.
2. Expanding Resilient Foams:
a. Acceptable alternative if manufactured for this purpose.
b. Minimum material density: 60 pounds per cubic foot.

2.3 SLEEVES

A. Materials:
1. 18-Gage Galvanized Steel: For pipe penetrations in non-bearings walls.
2. Schedule 40 Steel Pipe:
a. For all bearing walls.
b. For all floors.
3. Cast Iron Pipe: For all exterior below grade installations.

B. Size All Sleeves:
   1. To allow for movement due to expansion.
   2. To provide for continuous insulation.
   3. As indicated on the Drawings.

PART 3 - EXECUTION

3.1 INTERIOR WALL AND FLOOR OPENINGS

A. Use riser sleeve with integral flashing flange and clamp for all waterproof membrane floors.

B. Seal airtight all openings around pipes in the structure at Noise-Critical rooms:
   1. Lake House Rooms: 103, 107, 108, 109, 111, 112, 113, 115, 117, 118.
   2. Lake Hall Rooms: 158, 159, 161, 163, 164, 165, 166, 167, and Unoccupied Attic
   3. Penetrations of all drywall ceilings and concrete slabs suspended on isolators.
   4. All enclosed shaft penetrations.

C. Pipe Penetrations:
   1. Where a pipe passes through a wall, ceiling, or floor slab, cast or grout a steel sleeve into the structure.
   2. Internal diameter of the sleeve: 2 inches (50 mm) larger than the external diameter of the pipe passing through it.
   3. After all of the piping is installed in a specific area, check the clearance and correct it, if necessary, to within 1/2-inch (12 mm).
   4. Pack the void full depth with packing material and seal at both ends, 1-inch (25 mm) deep.
   5. In walls and floors of noise-critical spaces (see above), pack with sealant backed by foam rod.
   6. Where pipes pass through a masonry wall in sufficient numbers and density that individual pack-and-calk details are not possible, a special isolation detail shall be developed:
      a. Cast pipe sleeves in a block of concrete with the sleeves located a minimum of 2 inches (50 mm) apart.
      b. Block thickness: At least as thick as the surrounding wall construction.
      c. Each sleeve diameter: 2 inches (50 mm) larger than the external diameter of the pipe passing through it.
      d. Build the sleeved block into the wall.
      e. After the pipes are installed, pack and caulk voids as indicated above.
   7. Fire Protection and Compressed Air Pipes:
      a. May be sleeved and sealed as indicated above, or (except where crossing an acoustic joint) may be grouted and calked into the structure as follows:
         1) Before grout has set, rake a 1/2-inch deep (12 mm by 12 mm) groove around the pipe on each side of the wall or slab.
         2) After the grout has set, fill groove full depth with sealant.
      b. Penetration of sound isolating ceilings (concrete or multi-layer drywall) by fire protection pipes and heads shall be sleeved and sealed as indicated herein. There shall be no rigid connection between ceiling and pipes or heads.

3.2 OUTSIDE WALL OPENINGS

A. Pipes:
   1. Pass through sleeves fabricated of Schedule 40 pipe cut 3/8-inch back from face of wall on each side.
   2. Sealed 100% watertight.
   3. Pipes below grade use cast iron sleeves.

3.3 ESCUTCHEONS AND CLOSURE COLLARS

A. Includes ceilings, partitions, floor and walls.

B. Provide Escutcheons for All Piping:
   1. As indicated on the Drawings.
   2. Sized to fit over coverings.
   3. In All Dry Finished Areas: Chrome plated.
   4. Do not use escutcheons in acoustic isolation walls unless otherwise indicated.

END OF SECTION 21 05 31

SECTION 21 10 00 – WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the design, furnishing, and installation of a fire protection system:
   1. Water supply, above below ground singlewater source.
   2. Wet pipe system with sprinklers.
   3. Backflow preventer.
   4. Controls.
   5. Inspector's test station(s).
   6. Post indicator valve.

B. Division of Work: In accordance with the General Conditions, Construction Manager is responsible for dividing Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how Work may be divided. This is not a complete list of all Work:
   1. Fire Protection Subcontractor:
      a. Prepare system design and layout.
      b. Furnish and install all system piping and components including, but not necessarily limited to, flow switches, valve supervisory switches, and air pressure switches.
      c. Secure approvals from agencies having jurisdiction.
      d. Ensure that final installation, as constructed, complies with fire protection requirements and does not subject any part of this system to unnecessary risk of freezing or other damage.
   2. Electrical Subcontractor: Provide all necessary wiring interface and wire to building fire alarm system including, but not necessarily limited to, wiring of alarm bells, flow switches, valve supervisory switches, and air pressure switches.
   3. General Contractor:
      a. Provide access to all valves, sprinkler heads and devices.
      b. Provide louvers, heat trace or other means to protect all wet parts of the system from freezing.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ANSI/ASME Standards:
      a. A17.1 – Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks.
      b. B16.3 – Malleable-Iron Threaded Fittings, Classes 150 and 300.
      c. B16.9 – Factory-Made Wrought Steel Buttwelding Fittings.
      d. B16.25 – Buttwelding Ends.
      e. B36.10M – Welded and Seamless Wrought Steel Pipe.
   2. ANSI/AWWA Standard:
      a. C104/A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
      b. C110/A21.10 – Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids.
      c. C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
      d. C150/A21.50 – Thickness Design of Ductile-Iron Pipe.
      e. C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
   3. ASTM Specification:
      a. A53 – Specifications for Welded and Seamless Steel Pipe.
      b. A126 – Gray-Iron Castings for Valves, Flanges, and Pipe Fittings.
      c. A135 – Specifications for Electric Resistance Welded Pipe.
      d. A197 – Cupola Malleable Iron.

e. A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
f. B75 – Specification for Seamless Copper Tube.
g. B88 – Specifications for Seamless Copper Tube.
h. B251 – Specifications for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.

4. AWWA Standards:
   a. C105 – Polyethylene Encasement for Ductile Iron Pipe Systems.
   b. C500 – Metal-Seated Gate Valves for Water Supply Service.
5. AWS A5.8 – Specification for Filler Metals for Brazing.
6. NFPA Standards:
   a. 13 – Installation of Sprinkler Systems.
   b. 25 – Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
   c. 1963 – Standard for Fire Hose Connections.
7. UL:
   a. 193 – Alarm Valves for Fire Protection Service.
   b. 262 – Gate Valves for Fire Protection Service.
   c. 312 – Check Valves for Fire Protection Service.
   d. 668 – Hose Valves for Fire Protection Service.
   e. 753 – Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service.
   f. 789 – Indicator Posts for Fire Protection Services.
8. Factory Mutual Research Corporation (FM):
   a. Approval Standard 1035 – Nitrogen Generators

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. System layout and design responsibility are included as work of this Section.
   1. Details of construction, quantities, components and accessories indicated on the Drawings and in the specifications are minimum requirements.
   2. Minimum design criteria are as specified herein and as indicated on the Drawings.
   3. Confirm final design requirements with the authority or authorities having jurisdiction and the Owner's insuring agency.
   4. Increases in system component requirements beyond these minimums that are determined by the system designer to be necessary to provide the functional intent and for a complete system shall not be a basis for an increase in cost to Owner.
   5. Final Design:
      a. The equipment and piping sizes and selections, where indicated on the Drawings, are minimum requirements and have been determined through the application of good engineering practice and standard calculation methods based on the best information available at the time that these documents were produced. A complete layout and hydraulic analysis has not been done.
      b. It is the responsibility of Contractor to verify all assumptions and design elements used as the basis of the preliminary design and to perform final calculations, sizing and selections as necessary to comply with the performance criteria specified herein and NFPA 13.
      c. The primary water source, and only the primary water source (the supply pipe size and, if applicable, fire pump size and selection and water storage) as indicated in these documents is to be used as the basis for Bid. If, after completion of complete hydraulic analysis, a material change in any or all of the components of the primary water source is required, an adjustment in the Contract will be considered only after all layout and sizing options have been considered.
         1) A fire pump is not expected to be necessary to meet the requirements of this project. All layout and sizing options must be evaluated by hydraulic analysis before a pump will be considered.
      d. A 10% margin of safety shall be included.

B. Intent of Contract Documents:
   1. Indicate general areas to be sprinklered.
   2. Indicate primary water service location and size.
   3. Indicate flow and pressure test data used as basis for Drawings.
   4. Do not indicate complete system requirements.
   5. Do not necessarily indicate all incidental areas, such as attics, platforms and adjacent concealed spaces as may be required to be sprinklered.

C. Sprinkler System Layout:
   1. Sprinkler piping shall consist of straight tree, side feed tree, looped, or gridded configurations.
   2. Straight tree, side feed tree and looped configurations may be designed according to pipe schedule system or hydraulically calculation.
   3. Gridded configuration shall only be designed according to hydraulic calculation.

D. Occupancy Hazard Fire Control Approach:
   1. Water demand requirements shall be determined from the occupancy hazard fire control approach in accordance with NFPA 13:
      a. Special design approaches are allowed only in accordance with the provisions of NFPA 13.
   2. Occupancies or portions of occupancies shall be classified according to the quantity and combustibility of contents, the expected rates of heat release, the total potential for energy release, the heights of stockpiles, and the presence of flammable and combustible liquids.

E. Protection Area Limitations: Maximum coverage per occupancy hazard shall be as indicated below:
   1. Light Hazard: 52,000 square feet.
   2. Ordinary Hazard: 52,000 square feet.

1.5 SUBMITTALS

A. Preliminary Design Submittal:
   1. Provide in its entirety the following information:
      a. Name of Owner and occupant.
      b. Location, including street address.
      c. Point of compass.
      d. Building construction, obstructed versus unobstructed.
      e. Sprinkler spacing, location, style, temperature, finish and coating, on reflected ceiling plans.
      f. Water Supply:
         1) One or more adequate hydrants.
         2) Existing Water Mains: Size, type and location.
         3) New Water Connections and Mains: Size, type and location.
         4) Hydrant flow test conducted within the last 6 months: Location, elevation, seasonal low, date and time of test.
      g. Design Approaches, Plans, and Calculations:
         1) Most remote demanding area coverage.
         2) Density.
         3) C-factor for pipe.
         4) K-factor for sprinkler head orifice.
         5) Minimum flow, discharge pressure, water supply curve.
         6) Hydraulic calculations.
         7) Scaled plans of piping system with pipe sizes and node numbering indicated.
      h. Sprinklers:
         1) Style.
         2) Temperature.
         3) Finish and coating.
      i. Hangers:
         1) Maximum distance.
         2) Proper type for structure and pipe size.
      j. Pipes and Fittings:
         1) Correct joints for pipes.
         2) Fitting pressure rating.
         3) Special corrosion resistant piping.
         4) Sleeves through floors and walls.
      k. Valves:
         1) Control Valves: Type, locations, and supervision.
         2) Drains: Size, type, and adequacy.
         3) Inspectors test.
      l. Fire Department Connection:
         1) Location.
         2) Connection: Confirm thread index with responding fire department.

2. Obtain Approval From:
   a. Agency and authorities having jurisdiction.
   b. Including, but not limited to:
      1) Owner's insurer.
      2) State Fire Marshal.
      3) Local authorities.
3. Do not submit to approval agency until Engineer has reviewed the Submittal. Engineer's comments shall be incorporated into Drawings submitted to approving agency.

B. Final Design Submittal: Submit 8 sets, 2 of which shall bear approving agency stamp.

C. Engineer’s Design Submittal Review: Review of preliminary and final submittals does not relieve Contractor of responsibility for design and compliance with regulatory requirements and those of the Contract Documents.

D. Pressure Test Reports:
1. Submit within 1 week after each system pressure test.
2. List time, date and persons present for the following for each system:
   a. Initial tests.
   b. Final tests.
3. Include report indicating:
   a. Test type and duration.
   b. Initial pressure.
   c. Final pressure.
4. Indicate that necessary repairs and final tests were satisfactorily completed.

1.6 QUALITY ASSURANCE

A. Qualifications:
1. Installation Subcontractor: Certified by the state in which the work is performed.
2. Fabrication and Installation Personnel:
   a. Trained and experienced in the fabrication and installation of the materials and equipment.
   b. Knowledgeable of the design and the reviewed submittals.
   c. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

B. System installation and components shall comply with:
1. NFPA 13.

C. System testing shall comply with NFPA 25.

D. Comply with requirements of the following agencies:
1. Owner's insurer.
2. State Fire Marshal.
3. Local authorities having jurisdiction.

E. Agency Approvals: All components critical to operation or otherwise required by NFPA or the Owner’s insurer shall be documented for compliance with the following:
1. Underwriter Laboratories listed.
2. Factory Mutual approved.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage; contamination with foreign matter – each end of pipe shall be capped, plugged or taped; or damage by weather or elements; and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.8 SEQUENCING AND SCHEDULING

A. Contractor's attention is called to ductwork, heating piping, water and drain piping, and electrical systems. Coordinate these systems to avoid conflict in elevations of the systems where same may cross each other. Determine which trade shall start work first on project.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:
   1. Sprinkler Cabinets:
      a. Finished, wall-mounting, steel cabinet with hinged cover, with a minimum of 6 spare sprinklers plus sprinkler wrench.
      b. Include number of sprinklers required by NFPA 13 and sprinkler wrench.

PART 2 - PRODUCTS

2.1 PIPE, FITTINGS, AND HANGERS

A. Underground Pipe and Fittings:
   1. Ductile Iron Pipe, ANSI A21.50 and A21.51:
      a. Wall Thickness: Class 52, except as indicated otherwise.
      b. Cement Mortar Lining: ANSI A21.4.
   2. Joints:
      a. ANSI A21.11.
      b. U.S. Pipe TR FLEX restrained or equal.
   3. Main Line Fittings:
      a. Short Bodied, ANSI A21.10, Restrained Joint with Cement Mortar Lining:
         1) Restrained Joints: ANSI A21.11.
         2) Working Pressure: 250 psi.

B. Above Ground Pipe and Fittings:
   1. Pipe:
      a. Steel Pipe in Accordance with ASTM A135, or ASTM A53:
         1) Welded: Schedule 40.
         2) Threaded or Cut Groove:
            a) Schedule 40 for sizes less than 8 inches.
            b) Schedule 30 for sizes 8 inches or larger.
   2. Fittings:
      a. All steel, cast iron, and ductile iron fittings used on galvanized piping shall be galvanized.
      b. Standard weight steel, butt weld type conforming to ANSI B16.9 and ASTM A234.
      c. Screwed Fittings:
         1) Permitted in pipe sizes 2 inches and smaller.
         2) Conforming to ANSI B16.3 or B16.4, as applicable, and ASTM A197.

C. Quick Fit Sprinkler Tee:
   1. For use in warehouses or plant areas.
   2. Manufacturer: Victaulic; or approved equal.
   3. Description:
      a. Cast iron housing in accordance with ASTM A126.
      b. Finished with a rust inhibitor paint.
      c. Minimum of 1 carbon steel bolt on each side of sprinkler head connection.
      d. Gasket in accordance with ASTM D2000.

D. Flexible Connectors: Not allowed

E. Hangers and Supports: Comply with requirements of Division 21 Section “Hangers and Supports for Fire Suppression Piping and Equipment” for selection of pipe hangers and supports.

F. Bending – Schedule 40 and Type K and L Copper:
   1. 2 inches and smaller pipe requires radius of 6 pipe diameters.
   2. 2-1/2 inches and larger pipe requires radius of 5 pipe diameters.

G. Return Bends:
   1. Return bends are required on all non-potable water systems.
   2. Return bends are not required on deluge and dry pendant sprinkler systems.
   3. Grooved pipe couplings and fittings as specified in Division 21 Sections “Steel Pipe and Fittings for Fire Suppression” and “Copper Pipe and Fittings for Fire Suppression.”

2.2 SPRINKLER SPECIALTY FITTINGS

A. Fittings:
   1. UL listed or FM approved, with 175 psig minimum working pressure rating, and made of materials compatible with piping:

B. Sprinkler Drain and Alarm Test Fitting: Cast or ductile iron body with threaded or locking lug inlet and outlet, test valve, and orifice and sight glass Manufacturers:
   1. Fire-End and Croker Corporation.
   2. Tyco Fire Products.
   3. Victaulic Series 747.
   4. Viking Corporation.

C. Sprinkler Branch Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler Manufacturers:
   1. Elkhart Brass Manufacturing Company, Inc.
   2. Fire-End and Croker Corporation.
   3. Potter-Roemer; Fire-Protection Division.

D. Sprinkler Inspector’s Test Fitting: Cast-bronze or ductile-iron housing with threaded or grooved inlet and drain outlet and sight glass Manufacturers:
   1. AGF Manufacturing Company.
   2. Triple R Specialty of Ajax, Inc.
   3. Tyco Fire Products.
   4. Victaulic Style 720 “TestMaster II.”

E. Automatic Air Vents: Wet Pipe System Vent: Brass body automatic air venting valve, integrated ball valve, stainless steel strainer, purge valve with 3/4-inch NPT outlet, Manufactured by AGF PurgenVent, or equal.

2.3 SPRINKLER HEADS

A. UL listed with 175 psig minimum pressure rating.

B. Manufacturers:
   1. Viking.
   2. Reliable Corporation.
   3. Tyco.
   4. Victaulic.

C. Bulb: Temperature rating of temperature activated color coded glass bulbs or fused link plates in accordance NFPA 13 or as dictated by authority having jurisdiction.

D. Mounting and Finish:
   1. In areas with suspended ceilings, provide concealed type sprinklers with factory standard white cover plate Rooms indicated on drawings to be provided with custom color covers shall be p9 Sherwin Williams SW0045 Antiquarian Brown.
   2. In areas without suspended ceilings, heads shall be bronze finish, up-right type.
   3. Bronze finish pendent heads may be used in Storage Rooms and Janitor's Closets.
   4. Provide and install sprinkler guards when sprinkler subject to mechanical injury or when ceiling is at 7-0" or less to finished floor.
   5. Sidewall chrome plated sprinklers for extended coverage or as required: Restrain wall-mounted sidewall sprinkler to prevent movement.
   6. Dry sprinkler heads shall be used on any part of a wet system subject to freezing.

2.4 VALVES

A. UL listed or FM approved with a 175 psig minimum pressure rating. When water pressure exceeds 175 psi, valves shall be used in accordance with their pressure ratings.

B. Interior Valves:
   1. Manufacturer:
      a. Clow.
      b. Crane.
      c. Grinnell.
      d. Hammond.
      e. Milwaukee.
      f. Nibco.
      g. Victaulic.
   2. 2-1/2-Inch and Larger: Cast iron, flanged, IBBM gate, or butterfly valves.
   3. 2 Inches and Smaller: Bronze gate valves.
   4. UL 262.

C. Sectional Control Valve(s):
   1. Manufacturer: East Jordan Iron Works Series A18; or equal.
   2. Gate valve with nonrising stem, mechanical joint 1 end and flanged joint opposite end.
   3. Provide three-section cast iron adjustable valve box and cover at grade.

D. Post Indicator Valve(s):
   1. Manufacturer: Kennedy Valve Figure 71X; or equal by Nibco, Stockham, or Victaulic.
   2. Gate valve with cast iron body mechanical joint ends, bronze mounted, nonrising stem and parallel seats.
   3. Provide indicator post equal to Kennedy Figure 541 or Victaulic Series 774 complete with wrench for each post.
   4. Provide with flanged ends with indicator reading "Open" or "Closed", extension section as required for mounting height of 30 inches aboveground, angle wrench, counterclockwise opening, painted fire protection red.
   5. Valves to be factory tapped for supervisory switch. Fire Protection Subcontractor shall provide and install supervisory switches on all valves (switches to be approved type).

E. Swing Check Valve(s):
   1. Manufacturer: Viking Models D-1 (2-1/2-inch), D-2 (4-inch), E-2 (8-inch); or equal by Clow, Crane, Grinnell, Hammond, Stockham or Victaulic.
   2. Bosses Tapped:
      a. 1/2-inch for 2-1/2-inch through 4-inch sizes.
      b. 3/4-inch for 6-inch through 8-inch sizes.
   3. UL 312.
   4. Valve with ductile iron body, steel hand hole cover, stainless steel clapper, brass seat, rubber faced clapper.
   5. Flanged or groove end connections.

F. Detector Check Assembly (Backflow Preventer):
   1. Detector check assembly based on Watts. Detector check assembly by the following manufacturers of the same size, type, capacity and meeting other requirements may be furnished at the Contractor's option:
      a. Ames.
      b. Clayton.
      c. Febco.
      d. Hersey.
      e. Lawler.
      f. Wilkins.
      g. Aero.
   2. Double check detector assembly to be Watts Series 757 DCDA with 2 check valves, 2 O.S.&Y. isolation gate valves, test cocks and bypass with meter and backflow preventer. Bypass backflow preventer assembly to be listed to same standards as primary backflow preventer. Detector check to be an approved assembly as listed by the Division of Water. Bypass meter to be approved by and/or obtained from the Division of Water.
   3. Assembly to be in compliance with ASSE Standard No. 1048, U.L. listed and FM approved. Size as indicated on Drawings.

G. Alarm Check Valve:
   1. Manufacturer: Viking Model H-2; or equal by Reliable, Tyco. or Victaulic Model 751.l.
   2. UL 193.
   3. Valve with ductile iron body, steel hand hole cover, stainless steel clapper, brass seat.
   4. Accessories to standard trim package, meeting requirements of applicable rules and codes, shall include the following:
      a. Variable pressure trim package.
      b. Retarding chamber.
      c. Water pressure gages.
      d. Alarm devices.
   5. Valve can be installed vertically or horizontally.
   6. Retarding Chamber:
      a. 1/2-inch NPT inlet, 3/4-inch NPT outlet, 1-gallon capacity.
      b. Ductile iron body, self draining.
      c. Accessories include alarm test shut-off valve and 1/8-inch drain restriction. Include circuit closer vent assembly when electric pressure switch is installed without water motor alarm.

H. Manifold Check Assembly:
   1. Manufacturer: Victaulic Series UMC; or equal.
   2. UL Listed or FM Approved.
   3. Ductile iron construction, incorporating a control valve, check valve, flow switch, test and drain assembly, adjustable relief valve, and system gauges in 1 compact body/footprint, and shall be manufactured for "right" and "left"-hand orientations. The test and drain assembly shall contain an adjustable relief valve, with a range of 175 to 310 psi. Universal manifold check valve shall be rated for use at the maximum service pressure of 300 psi.

I. Manifold Assembly:
   1. Manufacturer: Victaulic Series UM; or equal.
   2. UL Listed or FM Approved.
   3. Ductile iron construction, incorporating a control valve, flow switch, test and drain assembly, adjustable relief valve, and system gauges in one compact body/footprint, and shall be manufactured for "right" and "left"-hand orientations. The test and drain assembly shall contain an adjustable relief valve, with a range of 175 to 310 psi. Universal manifold check valve shall be rated for use at the maximum service pressure of 300 psi.

2.5 ALARMS

A. Manufacturers:
1. Potter Electric Signal.
2. System Sensor.
3. Kennedy.
4. Viking.
5. Grinnell.

B. Alarm Bell:
1. Notifier KMS Series, Potter PB Series; or equal.
2. 10-inch diameter, backbox kit, guard.
3. Wiring by electrical Subcontractor.
4. Coordinate voltage with fire alarm contractor.

C. Flow Switch(es):
1. Viking Model VSR-F (2-inch to 8-inch); or equal.
2. Paddle type, 120V-1 phase, 2 SPDT switches.
3. Furnish and installed by Subcontractor. Wiring and connection to alarm bell and building alarm system by Electrical Subcontractor.
4. All wiring and connection to building fire alarm panel by Electrical Subcontractor.

D. Valve Supervisory Switches: UL 753.
1. Gate Valve Supervisory Switches: Sprinkler Subcontractor to furnish and install gate valve and post indicator valve supervisory switches on all shut-off valves and gate valves in the Sprinkler System. Coordinate switches with fire alarm/electrical contractor to integrate into fire alarm system as required.

E. Air Pressure Switch:
1. Viking Model A-1.
2. NEMA 4, 120V-1 phase, SPDT switch.

2.6 CONNECTIONS

A. Manufacturers:
1. Elkhart Brass.
2. Croker.
3. Potter-Roemer.
4. Reliable.
5. Tyco.

B. Siamese Connection(s):
1. Projecting type, one-way through three-way, horizontal or Y-pattern, 2-1/2-inch connection, independent self-closing clappers, plugs, chains, and escutcheon plate.
2. Provide thread index system currently used by local fire department.
3. Finish: Polished brass.
4. Identification: Auto-sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

A. System Layout:
1. The extent of sprinkler systems and general arrangements of overhead piping and underground piping shall be as indicated on approved Shop Drawings.
2. Deviations there from may be made as required by inspection agencies, insuring agencies or as required due to interference with other equipment, structural members, ducts, etc., and shall be at no additional cost to Owner.
3. Provide additional heads as may be required for an approved system.
4. Distance from sprinkler to wall shall not exceed 1/2 of the allowable distance between sprinklers.

5. Small room rule: Small room rule may be executed when occupancy hazard has been determined as light hazard, unobstructed construction exists and the room does not exceed 800 square feet.
6. Shafts:
   a. Install 1 sprinkler at the top of the shaft, except if noncombustible, non-accessible duct shaft, electrical shaft or pipe shaft:
      1) If combustible surfaces, install sprinkler at each alternate floor level.
      2) If accessible and noncombustible, install one sprinkler at top and bottom.
   b. Elevator Shafts: Sprinkle at the bottom of elevator shaft so it does not get the cab electricals wet. NFPA 13, 2013, Paragraph 8.15.5.1 indicates placing the head not more than 2'-0" above pit floor. Sprinkler system must have a readily accessible shutoff valve (cannot be in a locked room) that is electronically supervised.
7. Stairways: Sprinkler shall be located beneath all stairways of combustible construction:
   a. If noncombustible shaft, provide sprinkler at the top of the shaft and under first landing.
   b. If landing is serving 2 or more separate fire divisions, locate sprinklers at the same level as the landing and as required at each landing.
8. Building Service Chute: Sprinklers are required above top service opening, above lowest service opening, and above service openings at alternate levels in buildings over two stories.
9. Dry sidewall sprinkler in unheated spaces.

B. Conflicts:
   1. Report discrepancies or conflicts discovered to Engineer.
   2. Do not proceed with work until a satisfactory resolution is found.
   3. No additional compensation will subsequently be made interferences due to Contractor's negligence, error, oversight or other cause in not having properly established the elevations of all new or existing piping.

C. Access and Protection: Notify General Contractor of any parts of the system requiring additional measures to provide access or to protect from freezing or damage.

3.2 APPLICATION SCHEDULE:

Application Schedule				
	Application	Design Temperature Range	Maximum Pressure	Acceptable Pipe/Coupling (See Note Below)
	Wet pipe sprinklers	-30 to 230 degrees F	300 psig	A B
Note – Pipe/Coupling Types:				
A.	Standard weight steel pipe.			
B.	Light wall steel pipe.			

3.3 INSTALLATION

A. Sprinkler Heads:
   1. Location:
      a. Locate sprinkler heads in suspended ceilings symmetrical with lights, diffusers, and ceiling tile layout. Conceal piping in ceiling space.
      b. Locate sprinkler heads in the center of lay-in ceiling tiles.
      c. Head locations must be reviewed by Architect prior to installation.
      d. Identify to Contractor any heads that may become subject to freezing or damage.
   2. Special Coatings for Sprinkler Heads:
      a. Install listed corrosion-resistant sprinklers in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist.
      b. Corrosion-resistant coatings shall be applied only by the Manufacturer of the sprinkler:
         1) Exception: All damage to the protective coating occurring at the time of installation shall be repaired at once using only the coating of the Manufacturer of the sprinkler in the approved manner so that no part of the sprinkler will be exposed after installation has been completed.

c. Non-Corrosive Environments:
   1) Unless applied by the Manufacturer, sprinklers shall not be painted, and all sprinklers that have been painted shall be replaced with new listed sprinklers of the same characteristics, including orifice size, thermal response, and water distribution. Exception: Factory-applied paint or coating to sprinkler frames shall be permitted in accordance with NFPA 13.
   2) Ornamental finishes shall not be applied to sprinklers by anyone other than the sprinkler Manufacturer, and only sprinklers listed with such finishes shall be used.
d. Sprinkler heads in foyer shall be mounted in the sidewall of the bulkheads – not exposed.

B. Piping:
1. Piping shall be concealed in areas with ceilings and bulkheads and exposed in areas without ceilings.
2. Support:
   a. Piping shall be installed and supported in accordance with NFPA 13.
   b. All sprinkler piping shall be supported from the building structure.
   c. Hanger spacing shall be in accordance with NFPA 13.
   d. Hanger rod size shall be in accordance with NFPA 13.
   e. Maximum unsupported length between the end sprinkler and the last hanger shall be in accordance with NFPA 13.
   f. Cross mains shall be supported by at least 1 hanger between each 2 branch lines.
   g. As a minimum, risers in buildings with ceilings over 25 feet high shall be supported at each riser pipe section. In multi-story buildings support risers at lowest level, at each alternate level above, below offsets and at the top of risers.
   h. Hangers in general are covered in NFPA 13. If the system is other than a standard water sprinkler system, the applicable NFPA Standard shall also be consulted.
3. Cutting and Grooving:
   a. All flexible pipe fittings including grooved, cut and plain end and all quick fit fittings shall be installed with a machine specifically designed for this purpose.
   b. All piping to be grooved and cut shall be prepared using this specifically designed machine.
4. Drainage:
   a. Install piping to allow for drainage.
   b. Provide drains at base of risers, on valved sections, at Siamese connections and at other locations for complete drainage of system.
   c. Pipe drains to floor drain, service sinks, hub outlets or as approved.
5. Penetrations: Comply with the requirements of Division 21 Section “Penetrations for Fire Suppression.”

C. Inspectors Test Station:
1. Provide inspector test connections.
2. Pipe to outside of building or some other location where water damage will not result.

3. Automatic Air Vents: Install air vents in accordance with NFPA 13 located near a high point on each system.

3.4 PIPING SYSTEM PRESSURE TEST

A. General:
1. Perform all tests before piping is painted, covered, concealed or backfilled.
2. Before testing, remove or otherwise protect from damage, control devices, air vents, fixtures, meters, or other parts which are not designated to withstand test pressures.

B. Test Procedures:
1. Charge with water to the pressure specified.
2. Exterior Surface of Pipe and Fittings:
   a. Show no cracks or other form of leaks.
   b. Completely drip dry.

C. Pressure Test Criteria: Test criteria below are minimum requirements. In addition, the requirements of State and Local Codes having jurisdiction shall be met:
1. Piping System: Water (fire protection).
2. Type Test: Water.
3. Pressure: 200 psig.

4. Allowable Pressure Drop: 0 psi.
5. Minimum Test Duration: 2 hours.

3.5 PAINTING AND LABELING

A. Painting of this work is limited to the exposed pipe, fittings and hangers. Do not paint sprinkler heads.

B. Provide labels as specified in Division 21 Section “General Fire Suppression Provisions.” Comply with OSHA "Safety Color Code for Marking Physical Hazards".

END OF SECTION 21 10 00

SECTION 22 05 00 – GENERAL PLUMBING PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes specifying the general requirements for execution of that portion of the Work defined in Division 22 of these Specifications and as indicated on the Drawings:
   1. Major items include, but are not necessarily limited to:
      a. Concrete foundations and support steel.
      b. Piping, fittings and valves.
      c. Piping and equipment insulation.
      d. Piping and equipment painting.
      e. Temperature and pressure gages.
      f. Excavation and backfilling required.
      g. Plumbing equipment.
      h. Labor, materials, equipment, tools, supervision and start-up services.
      i. Instructions to Owner regarding operation.
      j. Incidental and related items necessary to a complete and functionally operational installation of the Work.

B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the Work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the Work:
   1. General Contractor:
      a. Install access doors.
      b. Provide concrete isolation and housekeeping pads for plumbing equipment.
      c. Provide access doors in walls and ceilings for access to plumbing equipment.
   2. Plumbing Subcontractor:
      a. Furnish location, size and quantity of openings to Contractor before construction of new walls, ceilings, and floors.
      b. Furnish size and locations of concrete equipment isolation and housekeeping pads as required for this Work and as indicated on the Drawings to Contractor before slabs are poured.
      c. Furnish size and location of access doors required for this work as indicated on the Drawings to Contractor.
      d. Provide excavation and backfilling required in connection with the Work of Division 22.
      e. Provide miscellaneous structural steel required in connection with support of the Work of Division 22.
      f. Perform final cleaning of plumbing systems and equipment.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of Division 22 shall comply with the following:
   1. ANSI:
      a. A13.1 – Standard for the Identification of Piping Systems.
      b. NSF/ANSI 61-2012 – Drinking Water System Components, Health Effects.
      c. NSF/ANSI 372 – 2011 – Drinking Water System Components, Lead Content.
   2. ASME: B31.9 – Building Services Piping.
   3. ASTM: A325 – Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   4. EPA: US Safe Drinking Water Act (US SDWA) – 2014.
   5. Michigan:
      a. Building Code of 2021.
      b. Plumbing Code of 2021.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Construction details, components, accessories, sizes and model numbers indicated on the Drawings or in these specifications are used to indicate minimum levels of quality and coordination requirements.

B. Equipment supplied, whether as scheduled or selected from list of acceptable Manufacturers, must meet minimum requirements listed in specifications or on Drawings, be compatible with facility and intended use, and meet requirements for a functional system.

C. Drawings:
   1. Are diagrammatic and indicate general arrangement of systems and work included.
   2. Do not necessarily indicate every required valve, fitting, trap, thermometer, gage, duct, elbow, transition, turning vane, mounting support and access panel.
   3. Shall not be scaled for measurement or installation location.
   4. Shall not serve as Shop Drawings.

D. Schedules and model numbers shall not be used to:
   1. Serve as final, definitive quantity requirements. Contractor shall make own count as indicated on Drawings.
   2. Determine proper type or model with arrangement, mounting and accessories applicable.

E. Coordinate installation work of Division 22 with work of other trades to provide a complete and functional system. Generally, the location of ductwork, sanitary, storm and vent piping take precedence over fire protection and HVAC piping, electrical conduit and cable trays.

1.5 QUALITY ASSURANCE

A. Comply with all State and Local requirements.

B. All products and components that conveys or dispenses water for human consumption through drinking or cooking must comply with US SWDA – 2014, NSF 61- 2012, and NSF 372-2011.
   1. Compliance must be certified and labeled by an independent accredited testing agency.

1.6 PRODUCT UNLOADING AND HANDLING

A. Unload equipment and materials required for completion of the Work.

B. Handle and store equipment and materials carefully to prevent damage. Method of rigging and handling shall be subject to the approval of an authorized representative of the equipment Manufacturer whose equipment is being handled.

1.7 TROUBLESHOOTING

A. By Contractor: If, during the start-up or warranty period, mechanical systems operational problems occur for which the root cause is not readily apparent, Contractor shall promptly, through a Subcontractor or other resource designated by Subcontractor, provide diagnostic and investigative services to determine the cause or causes.

B. By Engineer:
   1. At Contractor's request, Engineer will provide the services necessary to determine the cause or causes of the operational problems.
   2. Under the provisions of the General Conditions, Engineer will also provide these services if Contractor fails to respond satisfactorily to operational problems within a reasonable time after written notice from Engineer.
   3. If while working at Contractor's request or under the provisions of the General Conditions, Engineer determines that the problems are due to failure of the Work to comply with the requirements of the Contract Documents, Owner will compensate Engineer for additional services and deduct the amount paid from payment or payments to Contractor.

1.8 MAINTENANCE

A. Special Tools: Where special tools are required for operation, furnish these to Owner.

B. Loose and Detachable Parts:
   1. Retain loose and small detachable parts of the apparatus and equipment furnished until the completion of the Work.
   2. Turn over these parts to Owner.

C. Construction Strainers:
   1. Remove after flushing and cleaning and prior to turn over to Owner.
   2. Attach removed construction strainer to piping where removed as proof of removal.

PART 2 - PRODUCTS

2.1 FABRICATIONS

A. Miscellaneous Structural Steel:
   1. Comply with the requirements of Division 05 Section “Metal Fabrications,” where applicable.
   2. Structural steel work shall be done in accordance with the AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings, except that allowable stresses shall be reduced 25%.
   3. Where required, high strength structural steel bolting conforming to ASTM Specification A325 and assembled to AISC "Specifications for Assembly of Structural Joints. Using High Strength Steel Bolts" or welding shall be used in place of rivets.
   4. Connections shall be properly designed for the type of connection and the loads to be carried, and shall be subject to Engineer's or Owner's approval.
   5. Welding shall be done by operators who have been previously qualified by tests as prescribed in the American Welding Society "Standard Qualification Procedure" to perform the type of work required.
   6. Welding techniques shall conform to the American Welding Society "Code for Arc and Gas Welding in Building Construction", Section 4, Workmanship.
   7. Finished members shall be true to line and free from twist, bends and open joints.

B. Material installed in a ceiling plenum shall be either noncombustible or have a maximum flame spread of 25 and a maximum smoke developed rating of 50.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Character of Work: Installation shall be executed in a workmanlike manner and shall present a neat mechanical appearance when completed.

B. Laying Out of Work:
   1. Layout piping, equipment and components in accordance with the Contract Documents and the Manufacturer’s recommended practice, including provision of adequate space for maintenance. Review layout with Engineer prior to installation.
   2. Check drawings of other trades to verify spaces in which work will be installed. Maintain maximum head room and space conditions at all points. Where head room or space conditions appear inadequate, notify Engineer before proceeding with installation.
   3. If directed by Engineer, Contractor shall make reasonable modifications in the layout as required to permit proper execution of the Work and to prevent conflict with work of other trades.
   4. Work shall be installed so as to be ready for operation, maintenance and repair. Minor deviations from Drawings may be made to accomplish this. Changes shall not be made without approval of Engineer.

3.2 EXCAVATING AND BACKFILLING

A. Comply with the requirements of Division 31 Section “Excavation and Fill for Utilities.”

3.3 PIPE FITTINGS

A. Provide insulating couplings or unions where dissimilar materials are joined.

B. Provide unions at valves and at equipment for making repairs.

3.4 PAINTING

A. Paint exposed, insulated and non-insulated piping and equipment, in accordance with the requirements of Division 09 – Finishes.

B. Provide labels as specified below. Comply with OSHA “Safety Color Code for Marking Physical Hazards” and ANSI A13.1 for pipe labels and colors.

C. Valves, Fittings, and Supports:
   1. Paint valves and fittings the same base color as the pipe they adjoin.
   2. Paint floor stands the same base color as the pipe they adjoin.
   3. Paint wall brackets and pipe hangers the same base color as the wall or ceiling they adjoin, or gray, if wall or ceiling is not painted.

3.5 CODING AND TAGGING

A. Piping:
   1. Applied to new piping after installation, insulation, and final painting.
   2. Conform to Owner’s existing standards or conventions.
   3. Markings:
      a. Painted on, 1-inch high black letters.
      b. Color coded band, conforming to ANSI A13.1.
      c. Directional arrow.
   4. Place markers at 20-foot centers with at least 1 in each room, and at every change in direction.
   5. Plastic coated "Set Mark-Snap-Around" pipe markers manufactured by Seton Name Plate Corp., New Haven, Connecticut; or approved equal, may be used in lieu of painted markers and bands.

B. Valves:
   1. Provide brass or minimum 1/16-inch thick laminated plastic tags indicating assigned valve number on valves.
   2. Furnish schedule(s) of tagged valves with number, location and purpose of each valve.
   3. Place a copy of each schedule:
      a. In the Maintenance Instructions.
      b. In a string tie envelope labeled "Valve Schedule" and mount on the wall in Mechanical Room.

C. Where valves are located above the ceilings, a cadmium plated screw or such marking as designed by Engineer shall be located in the ceiling tile directly below the device.

D. Equipment:
   1. Provide for:
      a. Each water heater and pump.
      b. Labeled with its tag name/number as given on the Drawings.
      c. Use 2-inch high stenciled painted lettering.
   2. Similarly label control components associated with the above named equipment items.

3.6 START-UP

A. Comply with the requirements of Division 01 Section “Starting and Adjusting.”

3.7 ADJUSTING

A. Adjust and align equipment for smooth operation:
   1. Plumb true and with parts in proper position and alignment.
   2. Rotating parts shall turn freely and in the correct direction.
   3. Flexible couplings shall be checked for alignment subject to Owner's approval.
   4. Follow Manufacturer's instructions.

B. The work of installation shall be executed in conformity with the best practice, so as to contribute to efficiency of operation, minimum noise or vibration, minimum maintenance, accessibility and sightlines.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:
   1. Provide when required by individual Section.
   2. Provide the following services except where indicated otherwise in individual Sections:
      a. Inspect, check and approve system installation.
      b. Supervise system start-up.
      c. Provide written report indicating that system:
         1) Has been properly installed and lubricated.
         2) Is in accurate alignment.
         3) Is free from undue stress imposed by connecting lines or anchor bolts.
         4) Has been satisfactorily operated under full load conditions.
      d. Demonstrate operation of system to Owner's personnel.
      e. Instruct Owner's personnel on operation and maintenance of system.

B. Performance Test:
   1. Test the entire Work, including all of its individual systems for 2 weeks before final payment will be made.
   2. Every phase of plumbing plant shall be operated separately, or in conjunction one with the other to demonstrate to Engineer the ability of the plant to meet capacity and performance requirements while maintaining design condition, in accordance with the true intent and purpose of these Specifications.
   3. Make final tests in the presence of Owner and Engineer.
   4. If a part of the Work or equipment does not meet Specifications:
      a. Correct the situation.
      b. Obtain approval of Engineer before final payment is made.
   5. Provide the personnel and bear costs for correcting malfunctions.
   6. Owner will provide operating personnel and utilities.

C. Comply with the requirements of Division 01 Section “Starting and Adjusting.”

3.9 CLEANING AND FINISHING

A. Comply with the requirements of Division 01 Section “Cleaning and Waste Management.”

B. Entire installation shall be free from surface oil and grease before work will be considered for final payment.

C. After tests have been made and the system pronounced tight:
   1. Clean piping and equipment.
   2. Lubricate bearings.

D. Final cleaning includes but is not limited to the following:
   1. Equipment with Factory Finishes:
      a. Wash factory-finished equipment with mild soap and water and leave in first-class condition, entirely free of stains or streaks.
      b. Do not use abrasive materials. Touch up scratches or other violations of the factory finish paint with matching paint from the equipment Manufacturer prior to cleaning.

2. Plumbing Fixtures:
   a. Clean with mild soap and water containing a disinfecting agent.
   b. Set trim handles at same angle and polish.
   c. Remove, clean and reinstall aerators.
   d. Check pop-up wastes for proper operation.
3. Clean sumps, pits, trenches, manholes, catch basins and floor drains and leave free of foreign material.

END OF SECTION 22 05 00

SECTION 22 05 03 – STEEL PIPE AND FITTINGS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the basic requirements of steel pipe and fittings. Refer to Division 22 Section "Plumbing Piping and Specialties" for project specific requirements.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. American Society of Mechanical Engineers (ASME) Standards:
      a. B16.3 – Malleable Iron Threaded Fittings.
      b. B16.4 – Cast-Iron Threaded Fittings, Class 125 and 250.
      c. B16.5 – Pipe Flanges and Flanged Fittings, Steel Nickel Alloys and Other Special Alloys.
      d. B16.9 – Factory-Made Wrought Steel Buttwelding Fittings.
      e. B16.11 – Forged Steel Fittings, Socket Welding and Threaded.
      f. B16.21 – Nonmetallic Flat Gasket for Pipe Flanges.
      g. B18.2.1 – Square and Hex Bolts and Screws, Inch Series.
      h. B18.2.2 – Square and Hex Nuts.
      i. B31.9 – Building Services Piping.
   2. ASME Publications:
      a. Boiler and Pressure Vessel Code.
      b. Heating Boiler Code.
   3. ASTM Standards:
      a. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      b. A105 – Forgings, Carbon Steel, for Piping Components.
      c. A106 – Seamless Carbon Steel Pipe for High-Temperature Service.
      d. A126 – Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      e. A181 – Forgings, Carbon Steel for General Purpose Piping.
      f. A197 – Cupola Malleable Iron.
      g. A234 – Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
      h. A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      i. A 307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile.
      j. A312 – Seamless and Welded Austenitic Stainless Steel Pipe.

1.4 SUBMITTALS

A. Submit Manufacturer's Literature: For steel pipe and fittings. Include Manufacturer name, Manufacturer location, dimensions, and details of construction and installation.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Labeling: Piping materials shall bear the label, stamp or other marking of all specified standards and testing compliance, visible on the outside of the bare pipe.

C. Testing of Steel Piping: In accordance with Division 22 Section “Testing and Cleaning of Plumbing Systems.”

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
1. Except as herein specified or as indicated on the Drawings, all materials shall be in accordance with the Piping Systems Schedule in Part 3 of the appropriate applicable specification section.
2. Pipe 6'-0" and longer shall be permanently marked, visible on the outside of the bare pipe, with the following information:
   a. Manufacturer's name.
   b. Pressure rating.
   c. Standards met.
   d. Size.
3. All pipe joints shall be welded for pipe sizes 2-1/2 inches and larger.

B. Black Steel Pipe:
1. Black steel pipe shall be welded or seamless carbon steel, as specified for the type of service.
2. Welded black steel pipe shall meet the requirements of ASTM A53 or A106, and shall be Type F continuous-weld furnace butt-welding (CW), or Type E electric resistance welded (ERW) Grade B.
3. Seamless black steel pipe shall meet the requirements of ASTM A53 or A106, Type S seamless, Grade A or B.

C. Buried Piping:
1. Wrap with a pressure sensitive, adhesive backed, polyvinyl chloride or polyethylene tape:
   a. Spirally wrap straight pipe with 0.020-inch thick tape with minimum overlap of 1/2-inch.
   b. Spirally wrap 2 layers of 0.010 thick tape with minimum overlap of 1/2-inch.
   c. Manufacturers: 3M Company “Scotchwrap”; or approved equal.
2. Steel pipe with a factory applied polyethylene plastic coating such as Energy Coatings Company, “Pritec” may be used in lieu of wrapping specified above.

2.2 FITTINGS

A. Unions:
1. Pipe Sizes 2 Inches and Smaller :
   a. Forged steel with ground joint.
   b. Properly fitted for design temperature and pressure.
   c. 2,000-pound rated equal to Crane No. 250H or 251H.
   d. 3,000-pound rated equal to Crane No. 252H.
2. Pipe Sizes 2-1/2 Inches and Greater: Use companion flanges where unions are required.

B. Tapped Bosses:
1. Permitted in pipes and fittings.
2. 1-1/2-inch maximum hole size.
3. Boss Construction:
   a. Weld material built up to a thickness 50% greater than required threads.
   b. Forged bosses as approved by Engineer.
   c. 300 pound rated half couplings welded to pipe permitted for instrument connections 3/4-inch or smaller.

C. Screwed Fittings:
1. Cast iron in accordance with ASME B16.4.
2. Nodular or ductile iron in accordance with ASTM A395.

D. Welding Fittings:
   1. Meet ASTM A234 symbol WPA or WPB.
   2. The A or B grade shall conform to the grade of pipe used with the fittings.
   3. Dimensional standards shall conform to ASME B16.9.

E. Flanges:
   1. General:
      a. Welding neck or slip-on type with raised face.
      b. Conforming to ASME B16.5.
      c. Class 150 and 300 conforming to ASTM A181, Grade I.
      d. Class 600 and 900 conforming to ASTM A105, Grade II.
   2. Use threaded or socket weld type for piping smaller than 2-1/2 inches.
   3. Use flat face steel flanges when matching cast iron companion flanges.

F. Flange Gaskets:
   1. Non-asbestos compressed material conforming to ASME B16.21 and suitable for 600 degrees F service.
   2. Ring type, 1/16-inch thickness.
   3. Spiral wound stainless steel for service over 300 psi.
   4. Use full face gaskets with flat face flanges.

G. Bolting Material:
   1. General:
      a. Carbon steel, square-head bolts and Grade 2H hex nuts.
      b. Bolt length shall be sufficient to extend completely through nut with maximum 3/8-inch projection.
      c. Dimensions conforming to ASME B18.2 (bolts) and ASTM A194 (nuts).
   2. Bolts:
      a. For service below 250 psig/450 degrees F, use Grade B conforming to ASTM A307.
      b. For service at or above 250 psig/450 degrees F, use Grade B7 conforming to ASTM A193.

H. Socket Welding Fittings: All forged steel socket-welding fittings shall conform to ASME Standard B16.11 ASTM A105 Gr. II, equal to Crane 3,000-pound forged fittings.

2.3 MECHANICAL PIPING COUPLINGS

A. Manufacturers:
   1. Victaulic.
   2. Anvil.

B. General:
   1. All grooved piping materials shall conform with the specifications governing the systems or application for which they are used.
   2. All couplings and fittings shall be finished with hot-dip galvanizing of alkyd enamel paint.

C. Pipe and Tubing:
   1. Standard Weight Steel Pipe:
      a. Comply with the requirements of Division 22 Section “Steel Pipe and Fittings for Plumbing.”
      b. ASTM Schedule 40, A53 black steel or hot-dipped zinc-coated and seamless.

D. Couplings:
   1. Housing: Standard and Light Wall Steel Pipe: Ductile iron, ASTM A536.
   2. Style: Standard Steel Pipe:
      a. Rigid style.
      b. Victaulic “Zero-Flex” style 07.
   3. Gasket:
      a. Water Service: EDPM.
      b. Oil, Air and Vacuum Service: Nitrile.

4. Bolts – Nuts:
   a. Track bolts with 110,000 psi tensile strength.
   b. Heavy hex nuts.
   c. Zinc electroplated carbon steel.

E. Fittings:
1. Steel, ductile iron, copper or bronze.
2. Grooves or shoulders compatible with system couplings.
3. Segmentally welded fittings not acceptable.
4. Clamp-on mechanical tees not accepted.

F. Valves:
1. Refer to Division 22 Section “General Duty Valves for Plumbing,” or specification section governing the system or application for which they are used.
2. Compatible with grooved pipe coupling.

G. Strainers:
1. Refer to Division 22 Section “Plumbing Piping and Specialties.”
2. Compatible with grooved pipe coupling.

PART 3 - EXECUTION

3.1 PREPARATION

A. During Freezing Weather:
1. Protect all materials in such a manner that no harm can be done to:
   a. Installations already made.
   b. Materials and equipment on the Site.
2. Furnish all necessary protection for such installations and equipment as may be required.

3.2 ERECTION

A. General:
1. All Piping: Follow approved paths as indicated on the Drawings.
2. Connect to existing lines where required, or to equipment in an approved manner.
3. Locate Pipes, Valves and Equipment to Provide:
   a. Access for maintenance.
   b. Minimum obstruction of passageways and working space.
4. Normally, all pipe runs shall be plumb, parallel with the building and level, except for drain slope.
5. Be responsible for establishing and maintaining drain slope of piping in order to ensure drainage.
6. Expansion of Piping:
   a. All pipe connections shall provide freedom of movement of the piping during expansion and contraction without springing of piping or injury to building steel or structure.
   b. Any damage to building steel or structure as a result of work installed by Contractor shall be repaired at Contractor's expense.
7. As Piping Material is Erected:
   a. Thoroughly clean the inside of all piping.
   b. Remove foreign material such as scale, sand, weld spatter, particles and cutting chips.
8. Provide caps or plugs in all openings at the end of each day's work and as otherwise directed for the protection of the piping. Particular attention must be given to avoid the possibility of any foreign material entering the pipes.
9. Flanges shall be made on pipe so that the gasket surface forms an angle of 90 degrees with the pipe axis. Screwed flanges shall be made on until the pipe projects through the flanges and then the flanges must be refaced.

B. Sleeves and Holes:
   1. Contractor shall be responsible for cutting required holes and openings in floors, walls and other structures, except as noted on the Drawings. Sleeves will be placed by Contractor in all such openings, and no holes shall be cut without Owner's approval. Sleeves shall be in accordance with the standard details included in the Drawings.
   2. All holes in floors, walls, roofs, etc., where pipe lines or other materials have been removed or installed, shall be neatly and properly filled with concrete, brick or other material in accordance with the general character of the construction at the location.

C. Unions and Eccentric Fittings:
   1. Unions shall be provided at each screwed valve and where their use will facilitate dismantling of the piping and as required or directed in special cases.
   2. Eccentric fittings or eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur in the main due to the reduction in pipe size.
   3. All reducing fittings used at pump inlets shall be eccentric, flush on bottom and flush on the top for hydronic piping.
   4. Eccentric fittings shall keep the pipes flush on the bottom for steam and condensate piping.

D. Pipe Joints:
   1. Pipe connections at all valves shall be mechanically joined unless otherwise indicated on the Drawings or reviewed by Owner or Engineer.
   2. Pipe joints which will be buried or otherwise concealed shall be welded regardless of size.
   3. Mitered joints shall not be permitted.
   4. In general, black steel 2-1/2-inch and larger shall be welded except that a flange or union shall be provided at all valves and at equipment.
   5. The connections to welded 2-1/2-inch and larger pipe shall be made with a welding tee or Weld-o-let of butt, socket or threaded type as required. Scarf welding of side connections shall not be permitted.
   6. Only welding ells shall be used for changing pipe directions of welded pipe lines.

E. Pipe Welding:
   1. Where welding is called for, it shall be of the fusion process and shall consist of welding by means of either the oxyacetylene or electric arc process.
   2. All welding shall conform to the ASME Boiler and Pressure Vessel Code. All welders shall be qualified in accordance with ASME Standard Qualifications for Welding Procedures, Welders and Welding Operators, or Section 9 of the ASME Boiler and Pressure Vessel Code for the class of piping being welded. Submit welding qualifications for all welders on the Project when requested by Engineer.

3.3 MECHANICAL COUPLING SYSTEMS

A. Piping shall be prepared in accordance with the latest Manufacturer's specifications or other standards applicable.

B. Standard weight (Schedule 40 or heavier) steel piping may be roll grooved or cut grooved.

C. Couplings, fittings, valves and pipe shall be assembled in accordance with latest Manufacturer's instructions.

D. Support piping according to Manufacturer's maximum span recommendations or Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment," whichever is more stringent.

E. Raised face flanges shall have a metal flange washer installed.

F. Cutting, Grooving and Crimping:
   1. All flexible pipe fittings including grooved, cut and plain end and all quick fit fittings shall be installed with a machine specifically designed for this purpose.
   2. All piping to be grooved, cut and crimped shall be prepared using this specifically designed machine.

G. Mechanical joints are not allowed within walls.

H. Manufacturer's Field Service: Arrange and pay for Manufacturer's Engineer to provide the installation direction for a minimum onsite time of 1 day.
   1. Submit written approval of installation.

3.4 APPLICATION SCHEDULE

Application Schedule				
Application	Design Temperature Range	Maximum Pressure	Acceptable Pipe/Coupling (See Note Below)	
Domestic hot water	-30 to 230 degrees F	300 psig	A	B
Domestic cold water	-30 to 230 degrees F	300 psig	A	B
Roof drains/storm drains /sanitary drain and vent	-30 to 230 degrees F	300 psig	A	B
Note – Pipe/Coupling Types:				
A. Standard weight steel pipe.				
B. Copper Tubing: Refer to Section 22 05 09 – Copper Pipe and Fittings for Plumbing. NA. Not allowed for this application.				

3.5 ADJUSTING AND CLEANING

A. Clean and test piping in accordance with Division 22 Section "Testing and Cleaning of Plumbing Systems."

END OF SECTION 22 05 03

SECTION 22 05 06 – CAST IRON PIPE AND FITTINGS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the basic requirements of all cast iron pipe and fittings. Refer to Division 22 Section "Plumbing Piping and Specialties" for project specific requirements.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Specifications:
      a. A74 – Hub and Spigot Cast Iron Soil Pipe and Fittings.
      b. A888 – Hubless Cast Iron Soil Pipe and Fittings.
      c. C564 – Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
      d. C1277 – Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
   2. Cast Iron Soil Pipe Institute (CISPI) Specification:
      a. 301 – Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary System.
      b. 310 – CISPI's Patented Joints for Use in Connection with Hubless Cast Iron Sanitary System.
   3. AWWA Standard:
      a. Couplings for Use in Connection with Hubless Cast Iron Pipe and Fittings for Drain, Waste and Vent Piping Applications.
      b. C110 – Gray-Iron and Ductile-Iron Fittings, 3 inches through 48 inches, for water and other liquids.
      c. C111 – Rubber Gasketed Joints for Ductile-Iron Pressure Pipe and Fittings.
      d. C151 – Ductile Iron Pipe Centrifugally Cast in metal Molds or Sand Lined Molds for water or other liquids.
      e. C153 – Ductile Iron Compact Fittings, 3-inch through 24-inch.

1.4 SUBMITTALS

A. Submit in accordance with Division 01 Section "Submittal Procedures."

B. Manufacturer's Literature: For cast iron pipe and fittings and couplings. Includes Manufacturer name, Manufacturer location, dimensions, and details of construction and installation.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the installation of the material.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Regulatory Requirements: Comply with local code applicable to installation of the material.

PART 2 - PRODUCTS

2.1 HUB AND SPIGOT PIPE AND FITTINGS

A. ASTM A74, Service and Extra Heavy classes.

B. Gaskets:
   1. ASTM C 564.
   2. Elastomeric double seal compression type.

C. All pipe and fittings shall be made in the United States and bear the CISPI trademark.

2.2 HUBLESS PIPE AND FITTINGS

A. ASTM A888 and CISPI 301.

B. Couplings:
   1. ASTM C1277 Couplings.
   2. ASTM C1540 Heavy Duty Couplings.
   3. Corrosion resistant fasteners.
   4. ASTM C564 rubber sleeve with integral, center pipe stop.
   5. Above Ground or Corrosive Soils:
      a. Heavy Duty, Type 304, Stainless Steel Couplings: ASTM A666, Type 304, stainless steel shield; stainless steel bands; and sleeves.
         1) NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 3-inch wide shield with 4 bands.
         2) NPS 5 to NPS 10 (DN 125 to DN 250): 4-inch wide shield with 6 bands.
      b. Heavy Duty, Cast Iron Couplings: ASTM A48, 2 piece, cast iron housing; stainless steel bolts and nuts; and sleeve.
   6. Below Ground (Non-Corrosive Soils):
      a. Heavy Duty, Type 301, Stainless Steel Couplings: ASTM A666, Type 301, stainless steel shield; stainless steel bands; and sleeve.
         1) NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 3-inch wide shield with 4 bands.
         2) NPS 5 to NPS 10 (DN 125 to DN 250): 4-inch wide shield with 6 bands.

C. All pipe and fittings shall be made in the United States and bear the CISPI trademark.

PART 3 - EXECUTION

3.1 ERECTION

A. System shall be installed in accordance with Manufacturer's instructions and Code requirements.

B. Hubless piping shall not be used for pressurized applications.

3.2 JOINTS AND FITTINGS

A. Mitered joints will not be permitted.

B. Joints between CI soil pipe and "DWV" (drain, waste and vent) copper pipe are to be made with calking ferrule for bell and spigot pipe or a compatible adapter for hubless pipe.

C. Pipe and fittings shall be joined by 1 of the following 3 methods:
   1. Calked lead and oakum.
   2. Positive double seal elastomeric compression type gasket.
   3. No hub clamp assembly.

D. Service weight pipe shall be joined with service weight gasket.

E. Use extra heavy gasket with extra heavy pipe.

END OF SECTION 22 05 06

SECTION 22 05 07 – PLASTIC PIPE AND FITTINGS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the basic requirements of all plastic pipe and fittings. Refer to Division 22 Section "Plumbing Piping and Specialties" for project specific requirements.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Specifications:
      a. D1527 – Acrylonitrile-Butadiene-Styrene (ABS Plastic Pipe, Schedule 40 and 80.
      b. D1785 – Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
      c. D2239 – Polyethylene (PE) Plastic Pipe (SIDR-PR).
      d. D2282 – Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SIDR-PR).
      e. D2464 – Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
      f. D2466 – Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
      g. D2467 – Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
      h. D2665 – Poly Vinyl Chloride (PVC) Plastic Drain, Waste, and Vent (DWV) Pipe and Fittings.
      i. D2751 – Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
      j. D2846 – SDR11 Chlorinated Poly Vinyl Chloride (CPVC) Pipe and Socket Fittings.
      k. F439 – Chlorinated Poly Vinyl Chloride (CPVC) Fittings.
      l. F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
      m. F877 – Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all plastic pipe and fittings. Include material, properties and dimensions; and identification of piping system(s) for which submitted material will be used.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced with the material and the specialized installation tools.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Regulatory Requirements:
   1. Local codes having jurisdiction.
   2. Michigan Plumbing Code, latest edition.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Charlotte, Spears, J.M. Eagle, Watts, Uphonor/Wirsbo, Zurn, IPEX, Harvel.

2.2 POLYETHYLENE PIPE AND FITTINGS

A. PE, ASTM Pipe: ASTM D 2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 160 psig (1100 kPa).
   1. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
   2. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 160 psig (1100 kPa).
   1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 160 psig (1100 kPa).

2.3 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D 1785.
   1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

B. PVC, Schedule 80 Pipe: ASTM D 1785.
   1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
   2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

C. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket, and with spigot end.
   1. PVC Fabricated Fittings: AWWA C900, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
   2. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
   3. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
      a. Gaskets: AWWA C111, rubber.
   4. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
      a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 CPVC PIPE AND FITTINGS

A. All CPVC Schedule 40 and schedule 80 pipe shall be manufactured from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 23447 per ASTM D1784.

B. The pipe shall be manufactured in strict compliance to ASTM F441 and D2846, consistently meeting the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

C. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications.

2.5 IDENTIFICATION

A. Pipe and fittings shall have the following identification printed in indelible ink, hot-stamped or molded:
   1. Manufacturer's lot number.
   2. Manufacturer's name or trademark.
   3. Material designation.
   4. Nominal pipe size.

PART 3 - EXECUTION

3.1 ERECTION

A. All piping shall follow approved paths as indicated on the Drawings, connect to existing lines where required, or to equipment in an approved manner.

B. Location of pipe, valves and accessory equipment shall be arranged in the best possible manner, consistent with the Drawings, for accessibility and minimum obstruction of passageways and working space.

C. Pipe runs shall be plumb, parallel with the building and level, except for drain slope.

D. Unless noted otherwise, drain slope shall be a minimum of 1/8-inch per foot, or minimum as required by local plumbing code, whichever is greater, and shall be in the direction of flow where possible.

E. Plastic pipe shall meet local building code erection fire and smoke compliance standards and be installed underground or in an enclosed space with approved fire rated barrier.

3.2 PIPE JOINTS

A. Solvent Cementing:
   1. Plastic pipe to be cut square to allow the pipe to "bottom out" in the socket of the fitting.
   2. The pipe end to be beveled around the outside, and deburred on the inside to allow for proper fit.
   3. The plastic piping and inside of fitting to be cleaned with an approved pipe cleaner to ensure proper bonding of solvent cement.
   4. The jointing surface must be dissolved and made semi-fluid with sufficient solvent cement being applied to both surfaces to fill the gap between pipe and fitting.
   5. There shall not be a ridge of cement around the inside of pipe or fitting.

B. Joints between plastic pipe and copper, steel or cast iron piping to be made with local and state code approved adapters.

C. Approved polypropylene ferrule and slip nut joints may be used for pipe 2-inch or less above floor in equipment or furniture cabinet bases.

D. Schedule 80 pipe shall be threaded with special pipe dies for mating with Schedule 80 threaded fittings.

E. Use only Schedule 80 flanges to be jointed by either solvent cement or threaded connections.

F. Heat Fusion:
   1. For all polypropylene pipe systems.
   2. Use electrical fusing method.
   3. As recommended by Manufacturer.

END OF SECTION 22 05 07

SECTION 22 05 09 – COPPER PIPE AND FITTINGS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the basic requirements of copper pipe and fittings. Refer to Division 22 Section "Plumbing Piping and Specialties" for project specific requirements.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Specifications:
      a. B75 – Copper Fittings.
      b. B88 – Seamless Copper Water Tube.
      c. B306 – Copper Drainage Tube (DWV).
   2. ANSI Publications: A13.1 – Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

A. Manufacturer's literature: For copper pipe and fittings. Include Manufacturer name, Manufacturer location, dimensions, and details of construction and installation.

B. Manufacturer's literature for couplings and gasketing material.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.
   3. Installer of mechanical coupling piping system must be able to demonstrate a minimum of 5 years successful installation experience.

B. Testing of Copper Piping: In accordance with Division 22 Section "Testing and Cleaning of Plumbing Systems."

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration and contamination with foreign matter.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace removed materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Seamless Copper Tubing:
   1. Factory coded and marked.
   2. Conform to the following schedule:
      a. Aboveground: ASTM B88, Type L or K, hard drawn.
      b. Buried: ASTM B88, Type K soft temper.
      c. Drainage: ASTM B306, Type DWV.
   3. Pipe Markings:
      a. All piping longer than 2'-0" shall have a permanent marking in accordance with ASTM or ANSI specifications.
      b. This identification shall include the following:
         1) Manufacturer's name.
         2) Pipe pressure rating.
         3) Pipe size.

B. Solder type shall conform to the following:
   1. Hot and cold water and recirculation lines smaller than 2 inches: 95% tin, bismuth, copper and 5% silver.
      a. IAPMO listed lead free.
   2. Hot and cold water and recirculation lines 2 inches and larger:
      a. Silver Braze.
      b. IAPMO listed lead free.
   3. Drain Piping: 50% tin and 50% lead.
   4. Condensate Drain Piping: 50% tin and 50% lead.

C. Fittings:
   1. General Service:
      a. Sweat type, wrought copper, long radius elbows.
      b. Cast fittings shall only be allowed with written permission from the Engineer.
   2. Drainage:
      a. Sweat type, wrought copper, drainage pattern.
      b. Specialty items, such as closet elbows, may be cast brass.

2.2 MECHANICAL COUPLING PIPING SYSTEMS

A. Manufacturers:
   1. Victaulic.
   2. Grinnell.
   3. Viega.

B. Rigid Couplings:
   1. Housing: Ductile iron, ASTM A536; wrought copper or cast bronze.
   2. Style:
      a. Rigid style.
      b. Victaulic CTS style 606.
   3. Gasket:
      a. Water Service: EDPM.
      b. Oil, Air, Vacuum Service: Nitrile.
   4. Bolts – Nuts:
      a. Track bolts with 110,000 psi tensile strength.
      b. Heavy hex nuts.
      c. Zinc electroplated carbon steel.

C. Press Fitting:
   1. Copper and copper alloy fitting in compliance with ASME B16.18 or B16.22 and IAPMO PS 117.
   2. EPDM seal.
   3. Viega Pro-Press; or equal.

D. Fittings:
   1. Copper or bronze.
   2. Grooves or shoulders compatible with system couplings.
   3. Segmentally welded fittings not acceptable.
   4. Clamp-on mechanical tees not accepted.

E. Valves:
   1. Refer to Division 22 Section “General Duty Valves for Plumbing,” or specification section governing the system or application for which they are used.
   2. Compatible with grooved pipe coupling.

PART 3 - EXECUTION

3.1 PREPARATION

A. During Freezing Weather:
   1. Protect all materials in such a manner that no harm can be done to:
      a. Installations already made.
      b. Materials and equipment on the Site.
   2. Furnish all necessary protection for such installations and equipment as may be required.
   3. Grooved system copper piping shall be roll grooved without metal removal.

3.2 ERECTION

A. General:
   1. All Piping: Follow approved paths as indicated on the Drawings.
   2. Connect to existing lines where required, or to equipment in an approved manner.
   3. Locate Pipes, Valves and Equipment to Provide:
      a. Access for maintenance.
      b. Minimum obstruction of passageways and working space.
   4. Normally, all pipe runs shall be plumb, parallel with the building and level, except for drain slope.
   5. Be responsible for establishing and maintaining drain slope of piping in order to ensure drainage.
   6. Expansion of Piping:
      a. All pipe connections shall provide freedom of movement of the piping during expansion and contraction without springing of piping or injury to building steel or structure.
      b. Any damage to building steel or structure as a result of work installed by Contractor shall be repaired at Contractor's expense.
   7. As Piping Material is Erected:
      a. Thoroughly clean the inside of all piping.
      b. Remove foreign material such as scale, sand, weld spatter, particles and cutting chips.
   8. Provide caps or plugs in all openings at the end of each day's work and as otherwise directed for the protection of the piping.

B. Pipe Joints:
   1. Cut ends of copper tubing squarely using only sharp tube cutters.
   2. Ream pipe to full I.D. before preparing the joint.
   3. Soldering:
      a. Solder or braze joints by cleaning outside ends of all copper tubings and inside of fittings immediately before joining and soldering.
      b. Apply solder flux to both tube and fitting.
      c. Insert tube full depth into fitting, apply heat and solder in such a manner as to draw solder into and completely around the joint.
   4. Joining Valves:
      a. When joining copper lines to valves follow Manufacturer's instructions.
      b. In general:
         1) Valve shall be in the fully open position.
         2) Solenoid and expansion valves shall be broken down.

3.3 GROOVED PIPING INSTALLATION

A. Couplings, fittings, valves and pipe shall be assembled in accordance with Manufacturer's instructions.

B. Support piping according to Manufacturer's maximum span recommendations or Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment," whichever is more stringent.

C. Raised face flanges shall have a metal flange washer installed.

D. Cutting, Grooving and Crimping:
   1. All flexible pipe fittings including grooved, cut and plain end and all quick fit fittings shall be installed with a machine specifically designed for this purpose.
   2. All piping to be grooved, cut and crimped shall be prepared using this specifically designed machine.

E. Mechanical joints are not allowed within walls.

3.4 FIELD QUALITY CONTROL

A. Clean and test piping in accordance with Division 22 Section "Testing and Cleaning of Plumbing Systems."

B. Manufacturer's Field Service: Arrange and pay for Manufacturer's engineer to provide the installation direction for a minimum onsite time of 1 day.
   1. Submit written approval of installation.

END OF SECTION 22 05 09

SECTION 22 05 13 – COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all electric motors required for Division 22 specified equipment.

B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. Motors scheduled for interconnection with a variable frequency/variable speed drive control unit shall be furnished by the variable frequency drive supplier.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. NEMA – National Electrical Manufacturers Association – Standards and publications governing the following performance criteria:
      a. Frame design.
      b. Torque.
      c. Enclosures.
      d. Dimensions.
      e. Power supply and voltages.
      f. Locked rotor KVA per horsepower.
      g. Service factor.
      h. Sound power levels.
   2. NFPA 70 – National Electrical Code.
   3. ASHRAE 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, with state amendments.

1.4 SUBMITTALS

A. Manufacturer's Literature:
   1. All polyphase motors.
   2. All motors 3 horsepower (name plate) and larger.
   3. All Motors:
      a. Name and manufacturer.
      b. Type and model.
      c. Rated size.
      d. Type of bearings.
      e. Weight.
      f. AFBMA Rating
   4. Lubrication and maintenance instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of electric motors and their accessories, with minimum 3 years documented product development, testing, and manufacturing experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored onsite from weather and moisture by maintaining factory covers and suitable weatherproof covering.

B. For extended outdoor storage, remove motors from equipment and store separately in a protected area.

1.7 WARRANTY

A. Provide 2 year Manufacturer's warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Reliance.

B. Magnetek.

C. Baldor.

D. Lincoln Electric.

E. Subject to compliance with specifications, motors drawing less than 250 watts and intended for intermittent service may be supplied by an alternate Manufacturer commonly used by the equipment Manufacturer.

2.2 SPEED (EXCEPT WHERE NOTED OTHERWISE)

A. 1,800 rpm.

B. Constant speed.

2.3 CONSTRUCTION

A. Designed for continuous operation in 40 degree C environment, Class B insulation. Motors interconnected with a variable frequency drive shall be provided with Class F insulation and shall be inverter duty rated, and shall be outfitted with shaft grounding kit or isolated bearings.

B. All copper windings with a minimum service factor of 1.15 for totally enclosed, fan-cooled (TEFC) and 1.25 for open, drip-proof (ODP) motors.

C. NEMA frame, arrangement, and design as required for the specific application.

D. Permanently lubricated unless specifically noted otherwise.

E. Comply with all requirements for UL approval and labeling for specific hazard classification where explosion-proof and severe duty motors are indicated.

F. Provide a visible stainless steel nameplate indicating:
   1. Motor horsepower.
   2. Voltage.
   3. Phase.
   4. Cycles.
   5. RPM.
   6. Full load amps.
   7. Locked rotor amps.
   8. Frame size.

9. Manufacturer's name and model number.
10. Service factor.
11. Power factor.
12. Efficiency: Nameplate motor efficiency shall be identified in accordance with NEMA MG-1-12.54.2.

G. Except as specifically noted, all motors shall be high efficiency as listed in NEMA Standard 12.6 for all motors 1 horsepower and larger: All efficiency ratings are to be as tested in accordance with IEEE Spec. 112, Method B.

H. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

I. Variable frequency drive units and motors shall be matched for proper operating characteristics.

2.4 VOLTAGE AND MOTOR TYPE

A. Special conditions and voltage are noted on the Drawings.

B. Single Phase Power – Split Phase Motors:
1. Starting Torque: Less than 150% of full load torque.
2. Starting Current: Up to 7 times full load current.
3. Breakdown Torque: Approximately 200% of full load torque.

C. Single Phase Power – Permanent-Split Capacitor Motors:
1. Starting Torque: Exceeding 1/4 of full load torque.
2. Starting Current: Up to 6 times full load current.
3. Multiple Speed: Through tapped windings.

D. Single Phase Power – Capacitor Start Motors:
1. Starting Torque: Three times full load torque.
2. Starting Current: Less than 5 times full load current.
3. Pull-Up Torque: Up to 350% of full load torque.
4. Breakdown Torque: Approximately 250% of full load torque.
5. Motors: Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

E. 3-Phase Power – Squirrel Cage Motors:
1. Starting Torque: One to one and one-half times full load torque.
2. Starting Current: Six times full load current.
3. Power output, locked rotor torque, breakdown or pullout torque: NEMA Design B characteristics.
4. Design, construction, testing, and performance: Conform to ANSI/NEMA MG 1 for Design B motors.
5. Insulation System: NEMA Class B or better.
6. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Bearings:
   a. Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours.
   b. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension.
   c. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To ANSI/NEMA MG 1, 75 dBA SPL at 3 feet maximum.
9. Nominal Power Factor: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

2.5 RATINGS

A. Motors shall meet NEMA standards and be capable of operating at rated load with a voltage variation of ±10%, a variable of ±5% in rated frequency, or a combined variation of 10% without damage to the motor.

B. Motors shall be selected for the type of service involved and shall be selected at a minimum of 15% above the required rating of the equipment served. (Does not include service factor.)

2.6 THERMAL OVERLOADS

A. Provide built-in thermal overloads on all fractional horsepower motors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All materials and equipment shall be installed in accordance with Manufacturer's recommended installation methods for obtaining conformance with the Contract Documents.

B. Alignment of all motors, factory coupled or mounted, and all motors field coupled and mounted, shall be rechecked after all connections have been made and after 48 hours of operation in designed service.

C. Verify the voltage characteristics of each motor prior to ordering.

D. Verify the correct wire connections and rotation of equipment by "bumping" motor after wiring.

E. Confirm voltage imbalance on 3-phase motors is less than 2%.

3.2 APPLICATION: Except as specifically indicated, motors shall be selected as follows:

A. Shaded pole motors are not acceptable.

B. Phase, except where noted otherwise:
   1. 1/2 HP and Less: Single-phase.
   2. Larger than 1/2 HP: Three-phase.

C. Single Phase Starting:
   1. 1/8 HP and Less: Split phase or permanent split capacitor.
   2. Greater than 1/8 HP: Capacitor start.

D. Enclosure:
   1. Totally enclosed fan-cooled (TEFC) for all motors located outside, in wet areas, in mechanical rooms, or elsewhere as indicated.
   2. Open drip-proof (ODP) for motors located elsewhere, in a clean, dry environment.

END OF SECTION 22 05 13

SECTION 22 05 19 – METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all temperature and pressure gages. Unless otherwise specified, gages shall be as described in this Specification.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASME Standard:
      a. B40.1 – Gages – Pressure, Indicating Dial Type – Elastic Element.
      b. B40.30 – 1990 – Thermometers.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all gages and thermometers. Include name of Manufacturer, model, dimensions, and scale range.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ametek.

B. Ashcroft.

C. H.O. Trerice.

D. Miljoco.

E. Trend Instruments.

F. Weiss.

2.2 EQUIPMENT

A. Dial Thermometer:
   1. Bimetal type with adjustable dial face.
   2. 5-inch diameter dial.
   3. 6-inch nominal stem length.
   4. Union lock nut.
   5. Zero adjustment.
   6. Hermetic seal.
   7. Equal to H.O. Trerice B85600 Series.

B. Industrial Thermometer:
   1. Aluminum case, acrylic face, adjustable angle, blue spirit filled tubing.
   2. 9-inch scale.
   3. 3-1/2-inch nominal stem length. (6-inch for pipe sizes 6 inches and over).
   4. Equal to H.O. Trerice BX91 Series.

C. Pressure Gage:
   1. Bourdon tube type or bourdon coil type with direct coupled pointer, liquid filled.
   2. 4-1/2-inch minimum diameter.
   3. Accuracy of +1% of scale range.
   4. Equal to H.O. Trerice 450 Series.
   5. Liquid fill must be compatible with temperatures in measured fluid.

2.3 ACCESSORIES

A. Thermowell:
   1. Provide for all thermometers.
   2. 304 stainless steel.
   3. Equal to H.O. Trerice Cat. No. 138-0015.3 (138.0016.2 for pipe 6 inches and over).

B. Needle Valve:
   1. Provide for all pressure gages.
   2. Equal to H.O. Trerice Series 735.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all thermometers and pressure gages in conformance with:
   1. The Drawings.
   2. These Specifications.
   3. Manufacturer's recommendations.

B. Support all pressure gages and remote-reading thermometers:
   1. With 12-gage formed steel bracket.
   2. Secured to structure or equipment.

3.2 APPLICATION

A. Select all dial ranges such that normal operating temperature/pressure measured at point of installation is near mid-range.

END OF SECTION 22 05 19

SECTION 22 05 23 – GENERAL DUTY VALVES FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all valves.

1.3 REFERENCES

A. Except as specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.
   2. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
   3. Threaded: Valve ends complying with ANSI B2.1.
   4. Solder-Joint: Valve ends complying with ANSI B16.18.
   5. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. General:
   1. This Section is provided as a guide in the application and specification of specific valves intended for use in this Project. This Section does not instruct where to install these valves unless specifically noted. Refer to other specific Plumbing Specification Sections and Drawing details for instruction for location and use.
   2. As indicated on the Drawings.
   3. As called out in the Piping Systems Schedules.

B. Valves not specifically indicated on the Drawings:
   1. Size and class of valve to agree with line in which installed.
   2. All valves 2-1/2-inch and larger shall be flanged unless noted otherwise.
   3. All valves 8-inch and larger shall be furnished with suitable bypass valve and piping.

C. Valves shall have Manufacturer's name, trademark and working pressure rating cast into the valve body.

1.5 SUBMITTALS

A. Shop Drawings for all valves.

B. Manufacturer's Literature: For All Valves:
   1. Manufacturer's name.
   2. Details of construction.
   3. Performance characteristics.

1.6 QUALITY ASSURANCE

A. Made in USA:
   1. Unless specifically noted otherwise, all valves shall comply with the Federal Trade Commission Made in USA standard.
   2. Supplier shall furnish documentation of USA content if requested by Engineer.

B. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the material and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Valves shall be manufactured by one Manufacturer for each type of valve. Where valve Manufacturers are not specifically indicated, they shall be one of the following:
   1. Nibco.
   2. Kennedy.
   3. Crane.
   4. Milwaukee.
   5. Keystone.
   6. Stockham.
   7. Grinnell.
   8. Mueller Steam Specialties
   9. Jamesbury.
   10. DeZurik.
   11. Hammond.
   12. Apollo.
   13. Watts

2.2 MATERIALS

A. Bronze Valves:
   1. All brass alloys used in valves shall contain no more than 15% zinc.
   2. Alloys must comply with ASTM B61, B62 or B584.

2.3 HAND VALVES

A. General:
   1. Provide extended stem handles with a minimum clearance of 1-1/2-inch on insulated service.
   2. All valves used for throttling/balancing shall have adjustable memory stops.
   3. Pressure ratings are at service indicated by application.

B. Gate Valves:
   1. Gate valves used in connection with piping 2 inches in size and smaller shall be all bronze, union bonnet, rising stems, solid wedge taper seat, screwed or sweat ends and back seat, designed for 125 psi SWP. Valves used for piping 2-1/2-inch in size and larger shall be IBBM, OS&Y, bolted bonnet, rising stem, resilient solid wedge, bronze mounted, flanged ends, and designed for 125 pounds.
   2. Non-Potable Systems: Based on Nibco T-124 for 2-inch and less, Nibco F-617-O for 2-1/2-inch or larger.
   3. Potable Systems (Lead-Free): Nibco T-111-LF for 2-inch and less. Watts Series 408 for 2 1/2-inch and above.

C. Globe Valves:
   1. Threaded end 2-inch and smaller (125 psig and less): 125 pounds wsp, bronze body, rising stem, screwed bonnet, Teflon disc, Crane No. 7TF, or equal.
   2. Threaded end 2-inch and smaller (above 125 psig): Class 300, bronze body, rising stem, union bonnet, renewable SS seats, SS disc, Crane No. 382-P; or equal.
   3. Solder joint end 2-inch and smaller: 300 CWP, bronze body, rising stem, screwed bonnet, Teflon disc, Crane No. 1310; or equal.
   4. Flanged end 2-1/2-inch and larger (125 psig and less): Class 125, iron body, bronze trim, OS&Y bonnet, Crane No. 351; or equal.
   5. Flanged end 2-1/2-inch and larger (above 125 psig): Class 250, iron body, bronze trim, OS&Y bonnet, Crane No. 21E; or equal

D. Ball Valves:
   1. Ball valves used in connection with piping 2 inches in size and smaller shall have screwed or sweat ends, 2 piece bronze body, full port with stainless steel ball and a like stem. VA rated for 150 pound SWP and 600 WOG. Seats and seals shall be virgin teflon for standard duty cycle. Provide reinforced teflon for applications identified for extended duty cycle.
   2. 3 inches and larger shall be flanged or butt welded.

E. Butterfly Valves:
   1. Iron body rated for 175 psig and 250 degrees F, bubble-tight shutoff.
   2. Lug body for use with ANSI flanges. Wafer style is not acceptable, except where specifically approved.
   3. Bronze disk, 416 stainless steel shaft, EPDM seat.
   4. Provide neck extended 2 inches beyond flange diameter.
   5. DeZurik Figure BOS-US; or equal.

F. High Performance Butterfly Valves:
   1. Manufacturers: Bray – Braylok Series 41, Dezurik – BHP, Jamesbury – 815L, Milwaukee – HP Series, Tri-Seal Valve-Contromatics (formerly Watts/KF Contromatics), Xomox Pliaseal, ABZ ABZolute Seal Series 400.
   2. Full lug, high performance type, carbon steel body, 316 stainless steel disc, stainless steel shaft and bearing, PTFE seat, Teflon stem packing. Rated for 150 psi, 450 degrees F.
   3. For domestic water systems, full lug, high performance type, 316 stainless steel body, 316 stainless steel disc, stainless steel shaft and bearing, (all wetted parts stainless steel) PTFE seat, Teflon stem packing. Rated for 150 psi, 250 degrees F.

G. Drain Valves: Furnish at each low point 3/4-inch gate or ball valves as specified above. Install nipple with cap at valve outlet.

H. Plug Valves:
   1. Plug valves shall be nonlubricated eccentric plug type rated for 175 CWP with iron body neoprene coated plug and epoxy coated seat; equal to DeZurik PEC or Homestead Series 300. Furnish with compatible wrench. All valves used for throttling/balancing to have adjustable memory stop.
   2. Plug valves (gas cock) for natural gas shutoff applications shall be lubricated type equal to Homestead Figure 611 or 612 or Rockwell Figure 114 or 115.

2.4 CHECK VALVES

A. Silent Check Valve:
   1. Install silent check valves in all pump discharge.
   2. Piping less than 2-inch:
      a. High temperature, lead-free not required: 300 pounds, bronze body, renewable bronze disc screwed or sweat ends, bronze trim, Mueller, #103-MBP; or equal.
      b. Lead-free, up to 100°F; Mueller 101MAT or Watts LF600 for applications less than 15 psig.
      c. Lead-free, up to 250°F: Mueller 103MAT and where lead-free is required.
   3. Piping 2-inch and larger: 125 pounds, globe type, iron body, bronze trim, renewable seat and disc, SS springs, Mueller Steam Specialties, 101MAT, 103MAT; or equal.

B. Swing Check Valve:
   1. 2-Inch and Smaller: 125 psi valves for domestic hot and cold water.
      a. MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends.
      b. Provide valves capable of being reground while the valve remains in the line.
      c. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.
   2. 2-1/2-Inch and Larger for Domestic Hot and Cold Water, Heating Hot Water:
      a. MSS SP-71; Class 125 cast iron body and bolted cap conforming to ASTM A126, Class B; horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends.
      b. Provide valves capable of being refitted while the valve remains in the line.

PART 3 - EXECUTION

3.1 VALVE APPLICATION SCHEDULE

A. Cold Water, Hot Water and Hot Water Return System:
   1. Isolation through 2-inch: Ball Valve.
   2. Isolation 2 1/2-inch and Larger: High Performance Butterfly Valve, All stainless steel.
   3. Check: Swing Check through 2-inch, Silent Check for 2 1/2-inch and up.
   4. Balancing: Thermostatic Balancing Valve, Manual Balancing Valve.

3.2 INSTALLATION

A. Install valves in conformance with:
   1. The Shop Drawings reviewed by Engineer.
   2. The Manufacturer's recommendations.

B. Install Valves:
   1. At all branch piping connection to mains.
   2. At all connections to equipment.
   3. As required for complete control or isolation of any piece of equipment or service to branch lines.
   4. In accessible locations.
   5. Equal in flow area to connecting piping, unless otherwise indicated.

C. No valve shall be installed with its stem below the horizontal.

D. Furnish chain operated hand wheels, including rust-proof chain and chain guide for inaccessible overhead valves.

E. Install flanged valves at equipment in a manner which allows equipment side of valve to be opened up without draining piping system.

END OF SECTION 22 05 23

SECTION 22 05 29 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all pipe hanging and support systems.

B. Division of Work: In accordance with the General Conditions, Construction Manager is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. General Contractor: Coordinate work of this Section with other trades.
   2. Mechanical Subcontractor: All work of this Section except as listed under General Contractor.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASME – American Society of Mechanical Engineers:
      a. B31.9 – Building Services Piping.
      b. B31.8 – Gas Transmission and Distribution Piping Systems.
   2. MSS – Manufacturers Standardization Society:
      a. SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture Selection Application and Installation – 2009.
      b. SP-69 – Pipe Hangers and Supports – Selection and Application – 1996.
      c. SP-90 – Guidelines on Terminology for Pipe Hangers and Supports.

1.4 DEFINITIONS

A. Pipe Restraint: Pipe supporting element which is designed to limit or direct pipe movement due to internal static pressure, gravitational forces, frictional forces from hangers, rollers, and guides, and forces from expansion compensation devices:
   1. Pipe restraints are not designed to restrain pipe movement caused by thermal expansion, shock or surge.

B. Pipe Guide: A pipe restraint designed to direct pipe movement along a single axis.

C. Pipe Anchor: A pipe restraint designed to provide a static point about which pipe movement normally occurs, by limiting the longitudinal and axial movement at that point.

D. Other Terms: As defined in MSS SP-90.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated on Drawings or in these Specifications, this Contractor shall be responsible to design and provide all pipe hangers, supports, restraints, braces, framing, etc., as required to comply with all applicable building codes, ASME B31 and MSS SP-69.

B. Comply with the requirements of Division 22 Section “Sound and Vibration Control for Plumbing” for vibration isolation of piping.

C. Comply with the requirements of Division 21 Section “Water Based Fire Suppression Systems” for pipe hangers and supports for fire protection piping.

D. Comply with the requirements of ASME B31.8 for pipe hangers and support of natural gas piping systems.

1.6 SUBMITTALS

A. Manufacturer's Literature: For structural steel attachment devices, hangers and rollers. Include name of Manufacturer; model number and MSS Type, if applicable; and piping systems to be used with.

B. Submit Shop Drawings for all engineered hanger, restraints and support assemblies.

C. Upon request by Engineer, submit calculations for all engineered hanger, restraints and support assemblies.

1.7 PERFORMANCE REQUIREMENTS

A. Design Responsibilities:
   1. Anchorage of outdoor piping shall be designed by Contractor or their supplier.
   2. Minimum Requirements:
      a. Details, if any, indicated on the Drawings and Specifications contained herein are minimum requirements.
         1) Engineer has designed the structure to withstand the gravity and wind induced loadings of equipment.
         2) Notify Engineer of member size change requirements prior to fabrication.
      b. Generally comply with layouts and configurations as indicated on the Drawings.
   3. Structural Performance:
      a. Design shall be performed by a professional engineer.
      b. Design shall comply with the building code plus amendments and local ordinances, if any, legally adopted for the location in which the Project is located.
      c. Design anchorage systems capable of withstanding design loads within limits and under conditions indicated.
         1) The term "withstand" means that the unit will remain in place without separation of any parts from the device when subjected to the wind forces specified.
      d. Design shall include systems that transfer gravity and wind induced loadings (including lateral, overturning and uplift effects) to the structure, including, but not limited to:
         1) Anchorage between piping and supports.
         2) Anchorage between supports and building structure.
         3) Spacers, blocking, straps and the like.
   4. Design Loads:
      a. Dead Loads: Actual weights of materials and fixed equipment, as calculated by designer.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The materials of all pipe hanging and supporting elements shall be in accordance with the latest requirements of the ASME Code for Pressure Piping B31.1 and MSS Standard Practice MSS SP-58 and MSS SP-69 except as supplemented or modified by the requirements of these Specifications.

B. The material in contact with the pipe shall be compatible with the piping material so that neither shall have a deteriorating action on the other.

C. Special Finishes and Materials:
   1. All ferrous hangers and supports used in the following areas shall be hot dip galvanized unless noted otherwise:
      a. Outside.
      b. In wet or potentially wet areas.

2. 304 or316 stainless steel hangers and supports shall be used where exposed in the following areas:
   a. Outdoors.

2.2 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Elcon.
   2. Michigan Hanger.
   3. Anvil.
   4. Bergen.
   5. Hilti.
   6. Lindapter.
   7. Thybar.
   8. Pate.
   9. Miro.
   10. Roof Products and Systems.
   11. A.E.S.
   12. MicroMetl.
   13. PHD Manufacturing.

2.3 PIPE HANGERS AND SUPPORTS

A. Horizontal Piping Hangers: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).
   2. Yoke Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F (49 to 232 degrees C) pipes, NPS 4 to NPS 16 (DN100 to DN400), requiring up to 4 inches (100 mm) of insulation.
   3. Carbon or Alloy Steel, Double Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN20 to DN600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN15 to DN600), if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN15 to DN100), to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable Swivel Split or Solid Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8 (DN20 to DN200).
   7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN200).
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
   9. Adjustable Swivel Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).
   10. Split Pipe Ring With or Without Turnbuckle Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN10 to DN200).
   11. Extension Hinged or 2 Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN10 to DN80).
   12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30 (DN15 to DN750).
   13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

B. Supports and Rollers:
   1. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast iron floor flange.
   2. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast iron floor flange with U-bolt to retain pipe.
   3. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion type support for pipes, NPS 2-1/2 to NPS 36 (DN65 to DN900), if vertical adjustment is required, with steel pipe base stanchion support and cast iron floor flange.
   4. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN25 to DN750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.

5. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN65 to DN500), from single rod if horizontal movement caused by expansion and contraction might occur.
6. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN50 to DN1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
7. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN50 to DN600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
8. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN50 to DN750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

C. Vertical Piping Clamps: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).
2. Carbon or Alloy Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500), if longer ends are required for riser clamps.

D. Hanger Rod Attachments: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 degree F (49 to 232 degree C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type II, split pipe rings.
4. Malleable Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 degree F (49 to 232 degree C) piping installations.

E. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
1. Restraint Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
3. Spring Cushion Roll Hangers (MSS Type 49): For equipping Type 42 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from hanger.
6. Variable Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from base support.
7. Variable Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical type supports and 1 trapeze member.

2.4 HANGER RODS

A. Minimum rod diameters for rigid rod hangers shall be as shown in MSS SP-69 Table 4 (Minimum Rod Diameter for Single Rigid Rod Hangers) and as indicated in Part 3 of these Specifications.

B. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing.

C. Rod material must be compatible with hanger and comply with above. Do not field cut thread on galvanized rod.

D. Do not use perforated strap.

E. Multiple Supports:
   1. Horizontal banks of pipe may be supported on a common base member without regard to the pipe centerline elevation.
   2. In the supporting of multiple pipe runs, provisions shall be made to keep the lines in their relative lateral positions, using clamps or clips as required. Lines subject to thermal expansion shall be free to roll axially or slide.

2.5 SADDLES AND SHIELDS

A. All Piping:
   1. Saddle: MSS Type 39 Anvil Figure 160 to 165.
   2. Shield: MSS Type 40 (Anvil Figure 167), provide and install in accordance with Manufacturer's shield size selection tables.
   3. The contour of the saddle shall match the radius of the pipe insulation.

2.6 MANUFACTURED METAL FRAMING SUPPORT SYSTEMS

A. Acceptable Manufacturers:
   1. Eaton B-Line.
   2. Elcen.
   3. Super Strut, Inc.
   4. Unistrut Building Systems.

B. Provide products from one Manufacturer.

C. Channel (Standard Applications):
   1. Mild strip steel.
   2. 12-gage minimum material.
   3. Factory painted equal to Unistrut Perma-Green.
   4. Equal to Unistrut Part No. P1000.

D. Stainless Steel Channel and Accessories: For use outdoors.
   1. 304 or 316 stainless steel.
   2. 12 gage minimum material.
   3. Equal to Unistrut Part No. P1000SS.
   4. All clamps, supports and nuts to be similar stainless steel.

E. Clamps and Supports:
   1. Beam clamp equal to Unistrut Part No. P2785.
   2. Pipe strap equal to Unistrut Part No. P2558.
   3. Pipe roller equal to Unistrut Part No. P2474.
   4. All items fabricated in material equal to channel specifications.
   5. Copper pipes supported on metal framing support channels shall be protected from galvanic corrosion by special insulators between the pipe clamp and the channel.

F. Clamp Nuts:
   1. Electro-galvanized stainless steel for use with stainless steel and fiberglass parts.
   2. Mild bar steel for standard applications.
   3. Class 2 American Standard threads.
   4. Equal to Unistrut Part No. P1012.

2.7 BUILDING ATTACHMENTS

A. As indicated on the Drawings or in the Specifications.

B. Concrete Attachments:
1. Provide galvanized finish for all attachments used in wet or potentially wet areas.
2. Provide stainless steel bolts and nuts in wet and potentially wet areas.
3. Poured Concrete:
   a. Use cast-in-place inserts or bolted surface mounted attachments, at Contractor's option.
   b. Expansion style anchors are not permitted on piping systems subject to vibration.
4. Precast Concrete Tees:
   a. Use fittings specifically designed for attachment to stems of precast tees.
   b. Drilling is not permitted except where specifically approved by Engineer and coordinated with precast Manufacturer to miss embedded, prestressed steel strands.
5. Precast Concrete Plank:
   a. Use toggle bolt attachment as indicated on Drawings.
   b. Alternatively, provide adhesive anchor, Hilti HY-20; or as approved.
   c. Drilling is not permitted except where specifically approved by Engineer and coordinated with precast Manufacturer to miss embedded, prestressed steel strands.

C. Horizontal Piping:
1. Steel W, I, or S shapes: MSS Type 23 clamp with retaining clip, (Anvil Fig. 88, Fig. 89 for non-seismic and Fig. 89X for seismic applications) up to 2-inch; MSS Type 28 (Anvil Fig. 292) or MSS Type 21 (Anvil Fig. 133, 134) above 2-inch.
2. Steel Channel: MSS Type 20 universal channel clamp.
3. Bar Joists: Steel washer plate (Anvil Fig. 60).
4. Concrete: See "B" above.
5. Timber: Angle bracket and lag screws or as detailed on Drawings.
6. Steel Z Shapes: Custom attachment required. Submit details of welded or bolted attachment to Engineer.

D. Vertical Piping:
1. Steel Shapes: Welded brackets as approved by Engineer.
2. Concrete: See "B" above.
3. Timber: Ceiling hanger flange (Anvil Fig. 128R, 153) angle brackets and lag screws, or as detailed on Drawings.

E. In the absence of a Specification for a particular type of attachment, furnish attachments comparable in type and quality to that specified above for a similar situation.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. General Requirements:
1. The selection of pipe hangers and supports shall be based on the overall design concept of the piping system and any special requirements which may be called for in these Specifications or as indicated on the Drawings. The support systems shall provide for, and control, the free or intended movement of the piping including its movement in relation to that of the connected equipment. They shall prevent excess stress resulting from the transfer of weight being introduced into the pipe or connected equipment.
2. The selection of hangers and supports shall be made to provide the piping system with the degree of control that its operating characteristics require.
3. The selection of hangers or supports will take into consideration the combined weight of the supported systems, including system contents and test water.
4. Select and install hangers and supports to allow controlled thermal and seismic movement of piping system, to permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends and similar units.
5. The spans in MSS SP-69 Table 3 do not apply where concentrated weights, such as valves or heavy fittings, or where changes in direction of the piping occur between hangers.

6. Select all hangers and supports rated for the maximum potential loading with pipe full.
7. Select hangers for cold (less than 50 degrees F) piping service for installation over the insulation.
8. Where significant, vertical movement of pipe occurs at the hanger location a resilient support must be used:
    a. Selection of resilient supports shall be based on permissible load variations and effects on adjacent equipment. Support selection for typical load variations are shown on MSS SP-69 Table 2 (Spring Support Selection). Load and movement calculations shall be made for the proper selection of spring hangers.
    b. Vertical movement and load transfer from riser expansion to horizontal runs shall be given consideration when applying spring hangers.
    c. Spring cushion hangers may be used where vertical movement does not exceed 1/4-inch and where formal load and movement calculations are not required.
    d. Variable spring hangers shall be used for all other resilient support requirements except as noted in the following paragraph.
    e. Constant support hangers shall be used on piping systems where the deviation in supporting force must be limited to 6% and which cannot be accommodated by a variable spring hanger.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. General:
1. Adjust all components as required for proper operation and required pipe slope.
2. Double nut all support rods at hangers.
3. Location and Routing:
    a. Install Piping as Indicated:
        1) On the Drawings.
        2) On the reviewed Shop Drawings.
    b. Secure Engineer's approval for all pipe routing changes.
4. Coordinate with other trades for placement of concrete attachments prior to concrete pouring.
5. Install all items in accordance with Manufacturer's instructions.

C. Support at Valves: Provide additional supports at all valves in piping 4-inch and larger.

D. Vertical Risers:
1. Support independently from adjacent hangers on horizontal piping.
2. Cast Iron Waste, Vent or Drainage Piping:
    a. Support at the base and at each floor level.
    b. Support spacing not to exceed 15-foot centers.
3. Copper Piping:
    a. Support at the base and at 6-foot maximum centers for sizes 1-1/4-inch and smaller.
    b. Pipes Larger Than 1-1/4-Inch:
        1) Supported at each floor level.
        2) Not to exceed 10-foot centers.
4. Vertical Threaded, Welded or Grooved Steel Piping:
    a. Support at the base of the riser and at every other floor.
    b. Maximum allowable unsupported piping length is 12 feet.
5. Plastic Piping:
    a. Support at 4-foot centers maximum for sizes 1-1/2-inch or smaller.
    b. Support at the base and at 4-foot centers for all sizes larger than 1-1/2 inches.
    c. Completely encircle covering and insulating material.

E. Horizontal Runs:
   1. General:
      a. Provide adequate supports for the loads with a factor of safety of at least 5 (400 pounds minimum).
      b. Provide protective shield at all hangers and rollers supporting plastic pipe and coated pipe.
      c. Support spacing not to exceed MSS SP-69 Table 3, or the requirements for seismic restraint, whichever is more stringent.
      d. Hanger rod diameter shall not be less than the requirements of MSS SP-69 Table 4, or the requirements for seismic restraint, whichever is more stringent.
   2. Rollers: All piping systems designed to accommodate thermal expansion movement shall be mounted on rollers.
   3. Bar Joists: Attachments to bar joists shall be made to top member and at panel points.

F. Ductile Iron Piping: The size of hanger components shall be suitable for the O.D. of the pipe to be supported.

G. Cast Iron Soil Piping:
   1. The size of hanger components shall be suitable for the O.D. of the pipe to be supported.
   2. Spacing shall comply with MSS SP-69 Table 3.

3.3 PIPE RESTRAINTS

A. Provide adequate pipe restraints for all expansion or contraction of piping due to temperature change:
   1. Including, but not limited to, that indicated on the Drawings.
   2. As instructed by Owner or Engineer.
   3. At locations to prevent stresses from exceeding those permitted by ASME B31 and to prevent transfer of loading and stresses to connected equipment.
   4. Spacing: Unless otherwise indicated, install at ends of main pipe runs, at intermediate joints in pipe runs between expansion loops and bends.

B. Concrete work installed in connection with anchors or supports: Make with approved Portland Cement:
   1. At least 5-1/2 bags per cubic yard.
   2. Properly mixed with approved aggregate.
   3. Attain a compression strength of not less than 3,000 psi at 28 days.

3.4 VIBRATION ELIMINATORS

A. Provide as indicated on the Drawings and in accordance with the requirements of Division 22 Section “Sound and Vibration Control for Plumbing.”

B. Install so as to cause minimum restraint to normal thermal movements.

3.5 INSULATION PROTECTION

A. Provide Protection Saddle:
   1. Equal to insulation thickness.
   2. At each hanger.
   3. For all insulated piping systems where longitudinal expansion exceeds 1-inch per 100 feet.

B. Provide preservative treated wood block "saddle" for all insulated domestic cold water piping systems larger than 3-inch IPS. Anvil Fig. 160 to 165 is also acceptable.

C. Provide insulation protection shield:
   1. At each hanger for all "cold" (less than 50 degrees F) piping services.
   2. In accordance with the following table:

Pipe Size (IPS)	Shield Gage	Length
5 inches and Smaller	16	12 inches
6 inches to 12 inches	12	16 inches
Greater than 12 inches	12	20 inches

3. Installed as follows:
   a. Surround lower covering.
   b. Straddle equidistant on hanger.
   c. Flared at both ends as required to avoid damage to pipe covering, jacket and vapor barrier.

3.6 PAINTING

A. Touchup: Cleaning and touchup of painting of field welds, bolted connections and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

B. Galvanized Surfaces: Clean welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION 22 05 29

SECTION 22 05 31 – PENETRATIONS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Pipe sleeves.
   2. Prefabricated and site built curb assemblies.
   3. Flashing and sealing of all mechanical openings through weather or waterproofed walls, roofs and floors.
   4. Sealing and finishing of all mechanical openings.
   5. Provide UL rated firestopping and sealing at all new and existing pipe penetrations of fire rated walls.

B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. General Contractor:
      a. Locate and place all sleeved and framed openings as part of constructing the wall and floor surfaces in which the openings occur.
      b. Provide all lintels and required stiffening members for wall and floor openings.
      c. Cut roofing and install flashing for all required openings in proprietary roof membrane systems.
      d. Cut all roof deck openings and provide required framing supports.
   2. Mechanical Subcontractor:
      a. Advise General Contractor of quantity, location and size of all required openings.
      b. Provide all curbs, sleeves, seals, escutcheons and related materials required for finishing, sealing and waterproofing mechanical openings. Furnish all flashing and counterflashing.
      c. Arrange and pay for all openings required after wall, roof and floor construction is complete.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with ASTM D2202 – Test Method for Slump of Sealants.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all premanufactured curbs and sealing assemblies.
   1. Manufacturer's name.
   2. Model number.
   3. Details of construction and installation.
   4. Certified load-bearing data for all curbs.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Codes and Standards: "Architectural Sheet Metal Manual" as published by SMACNA.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Prefabricated Stack Sleeve Assemblies:
   1. Josam.
   2. Wade.
   3. Zurn.

B. Pipe Seals and Boots:
   1. The Pate Company.
   2. Portals Plus, Inc.
   3. Roof Products and Systems Corporation.
   4. Thunderline Corporation.
   5. Thycurb Corporation.

C. Modular Mechanical Seals:
   1. Thunderline/Link-Seal.
   2. As approved.

D. Backer Rod: Industrial Thermo Polymers, “Standard Backer Rod”.

E. Acoustical Sealant: Pecora, “BA-98”.

F. Expanding Resilient Foam: General Electric, “RTF762.”

2.2 MATERIALS

A. Backer Rod:
   1. Extruded round, closed cell, polyethylene foam.
   2. Resilient, non-exuding.
   3. Density: 2.0 pounds per cubic foot.
   4. Tensile Strength: 50 psi.
   5. Nonabsorbent to water and gasoline.
   6. Suitable for use as a backing for acoustical sealant.
   7. Compatible with sealant and approved by sealant Manufacturer.

B. Acoustical Sealant:
   1. Nonfire-Rated Penetrations:
      a. Non-drying, non-hardening and non-bleeding.
      b. Laboratory tested sealant which effectively reduces airborne sound transmission through wall systems.
      c. Viscosity: 350,000 to 400,000 (Brookfield No. 65, 10 RPM).
      d. Aging: Firm but rubbery, good tack after 50 days conditioned at 160 degrees F.
      e. Slump: 0.1 to 0.2 inches in accordance with ASTM D2202.
      f. Color: Gray.
   2. Fire-Rated Penetrations: Permanently flexible, approved firestop putty.

C. Packing Material for Penetrations:
   1. Glass Fiber or Mineral Fiber:
      a. Noncombustible.
      b. Resistant to water, mildew, and vermin.
   2. Expanding Resilient Foams:
      a. Acceptable alternative if manufactured for this purpose.
      b. Minimum material density: 60 pounds per cubic foot.

2.3 SLEEVES

A. Materials:
   1. 18-Gage Galvanized Steel: For pipe penetrations in non-bearings walls.
   2. Schedule 40 Steel Pipe:
      a. For all bearing walls.
      b. For all floors.
   3. Cast Iron Pipe: For all exterior below grade installations.

B. Size All Sleeves:
   1. To allow for movement due to expansion.
   2. To provide for continuous insulation.
   3. As indicated on the Drawings.

2.4 MANUFACTURED UNITS

A. Stack Sleeves and Flashing Fittings:
   1. Provide as required for roof and floor pipe penetrations.
   2. Equal to Josam 264xx series products.

B. Exterior Pipe Opening Seals:
   1. Compatible with installation conditions.
   2. Equal to One of the Following:
      a. Pate "Pipe Seal".
      b. Portals Plus Model C-126.
   3. Link-Seal.

C. Modular Mechanical Seals:
   1. Provide modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
   2. The elastomeric element shall be sized and selected in accordance with Manufacturer's recommendations and have the following properties as designated by ASTM:
      a. For Standard Service Applications:
         1) -40 to +250 degrees F (-40 to +121 degrees C).
         2) EPDM = ASTM D2000 M3 BA510.
      b. For High Temperature or Fire Seal Applications:
         1) -67 to +400 degrees F (-55 to +204 degrees C).
         2) Silicone = ASTM D2000 M1GE505.

PART 3 - EXECUTION

3.1 ROOF OPENINGS

A. Piping:
   1. As indicated on the Drawings.
   2. For Multiple Pipes Through Single Opening:
      a. Select sleeve of ample size to accommodate pipes.
      b. Prefabricated insulated curbs acceptable.
   3. Fill Annulus Opening:
      a. Use non-combustible insulation material.
      b. Full depth of sleeve.
   4. Provide Moisture Protection Using:
      a. Elastomeric boot.
      b. Metal hood.
      c. Flashing fitting.

B. Locate curbs and sleeves a minimum of 12 inches from walls to permit proper flashing.

3.2 INTERIOR WALL AND FLOOR OPENINGS

A. Flash all floor-mounted drains except in slabs on grade:
   1. Use integral flashing flange and clamp.
   2. As specified in Division 22 Section “Plumbing Pumps.”

B. Use riser sleeve with integral flashing flange and clamp for all waterproof membrane floors.

C. Seal airtight all openings around pipes in the structure at Noise-Critical rooms:
   1. Lake House Rooms: 103, 107, 108, 109, 111, 112, 113, 115, 117, 118.
   2. Lake Hall Rooms: 158, 159, 161, 163, 164, 165, 166, 167, and Unoccupied Attic
   3. Penetrations of all drywall ceilings and concrete slabs suspended on isolators.
   4. All enclosed shaft penetrations.

D. Pipe Penetrations:
   1. Domestic Water, Sewer, Drain and Vent Piping:
      a. Where a pipe passes through a wall, ceiling, or floor slab, cast or grout a steel sleeve into the structure.
      b. Internal diameter of the sleeve: 2 inches (50 mm) larger than the external diameter of the pipe passing through it.
      c. After all of the piping is installed in a specific area, check the clearance and correct it, if necessary, to within 1/2-inch (12 mm).
      d. Pack the void full depth with packing material and seal at both ends, 1-inch (25 mm) deep.
      e. In walls and floors of noise-critical spaces (see above), pack with sealant backed by foam rod.
      f. Where pipes pass through a masonry wall in sufficient numbers and density that individual pack-and-calk details are not possible, a special isolation detail shall be developed:
         1) Cast pipe sleeves in a block of concrete with the sleeves located a minimum of 2 inches (50 mm) apart.
         2) Block thickness: At least as thick as the surrounding wall construction.
         3) Each sleeve diameter: 2 inches (50 mm) larger than the external diameter of the pipe passing through it.
         4) Build the sleeved block into the wall.
         5) After the pipes are installed, pack and calk voids as indicated above.

3.3 OUTSIDE WALL OPENINGS

A. Pipes:
   1. Pass through sleeves fabricated of Schedule 40 pipe cut 3/8-inch back from face of wall on each side.
   2. Sealed 100% watertight.
   3. Pipes below grade use cast iron sleeves.

3.4 FLOOR SLEEVES IN POTENTIALLY WET AREAS

A. All floors except slabs on grade.

B. Extend sleeves 3 inches above finished floor.

C. Provide poured concrete curb for duct openings as indicated in the Drawings.

3.5 ESCUTCHEONS AND CLOSURE COLLARS

A. Includes ceilings, partitions, floor and walls.

B. Provide Escutcheons for All Piping:
   1. Sized to fit over coverings.
   2. In All Potentially Wet Areas: Stainless steel.
   3. In All Dry Finished Areas: Chrome plated.
   4. Do not use escutcheons in acoustic isolation walls unless otherwise indicated.

END OF SECTION 22 05 31

SECTION 22 05 46 – SOUND AND VIBRATION CONTROL FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all equipment for and related items incidental to isolation and attenuation of vibration and sound control of plumbing systems:
   1. Major Items:
      a. Isolate rotating or vibrating equipment with vibration isolators.
      b. Connect piping to equipment by means of flexible connections.
      c. Install equipment and piping on, or suspended from, approved and specified foundations or supports.
   2. All vibration isolation devices shall be furnished by a single Manufacturer.

B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. General Contractor: Provide concrete equipment pads.
   2. Plumbing Subcontractor:
      a. Provide miscellaneous structural steel necessary for support of mechanical work.
      b. Coordinate necessary alterations in structural steel.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASHRAE – 2015 Handbook – Table 47 of Chapter 48 – "Selection Guide for Vibration Isolation".
   2. ASTM:
      a. C665 – Specification for Mineral Fiber Blanket Thermal Insulation.
      b. E84 – Test Method for Surface Burning Characteristics of Building Materials.
      c. E90 – Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
      d. G21 – Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
      e. G22 – Practice for Determining Resistance of Plastics to Bacteria.
   3. NFPA Standard: 255 – Surface Burning Characteristics of Building Materials.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. The isolation materials Manufacturer shall be responsible for the proper selection of isolators to achieve the specified minimum static deflections, for all isolators, based on the actual weight distribution of equipment to be isolated.

B. The isolation materials Manufacturer shall be responsible for the structural design of steel beam bases and concrete inertia bases, to support equipment scheduled to receive such supplementary bases.

C. Be responsible for verifying the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this Specification. All additional equipment needed to meet the intent of this Specification, even if not specifically mentioned herein or in the Contract Documents, shall be supplied by the Contractor without claim for additional payment.

D. Sealing of Penetrations: Designated building structures designed to isolate air-borne noise surrounding all critical and noisy spaces. Proper routing of and sealing or lagging (enclosure), or both, around plumbing services penetrating these structures are necessary to maintain the integrity of the isolating structure.

E. Structural Isolation: Separations of building structures along acoustical joints have been designed to reduce structure-borne transmission of sound into critical spaces. Plumbing and electrical services must avoid rigid bridging across two structures isolated from each other.

1.5 NOISE CRITICAL SPACES

A. Many areas of this building require special attention (special acoustical provisions and restrictions) to the allowed background noise levels. The following areas are designated as “noise-critical” spaces:
   1. Mechanical Rooms.
   2. Kitchens.
   3. IT/AV Rooms.

B. Noise-critical walls are all walls enclosing the above spaces, and include spaces that contain noise producing equipment in addition to the “noise-critical” spaces listed above. Noise-critical slabs are those slabs (and all associated isolated ceilings or floating floor slabs) that are above and below rooms enclosed by noise critical walls.

C. Penetrations of noise critical walls and slabs by pipes and conduit shall be sleeved, packed, and sealed airtight with non-hardening sealant as described in Division 22 Section “Penetrations for Plumbing.”

1.6 SUBMITTALS

A. Manufacturer's Literature: For all products described under Part 2 of these Specifications.
   1. General:
      a. Dimensions.
      b. Construction details.
      c. Manufacturer's name.
      d. Model number.
   2. Spring Isolators:
      a. Rated deflection.
      b. Spring constant.
      c. Model number.
      d. Type of isolator.
      e. Size.
      f. Height when uncompressed and maximum allowed static deflection.
      g. Isolator location shown on an outline of the isolated equipment.
      h. Location of isolators on plan drawings of the isolated area, where applicable.
      i. The weight of all isolated equipment, and the loads on each isolator and the static deflection of each isolator under the specific design load shall be listed along with the proposed isolators.
      j. Pipe isolators shall be shown and identified on piping layout Drawings.

B. Furnish a complete set of approved Shop Drawings of all plumbing equipment to receive vibration isolation devices to the vibration isolation materials Manufacturer, based upon the selection of vibration isolators and design of supplementary bases will be completed. The Shop Drawings to be furnished shall include operating weights of the equipment to be isolated and the distribution of weight at support points.

1.7 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Manufacturer or Qualified Representative Services:
   1. Provide necessary field supervision.
   2. Ensure correct installation and adjustment.

C. Regulatory Agencies Requirements:
   1. Comply with all state and local codes and ordinances.
   2. Insulation, facing, and adhesive shall have a composite rating:
      a. 25 flame spread maximum.
      b. 50 smoke developed maximum.
      c. In accordance with NFPA 255.

1.8 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Vibration Control: All vibration control apparatus shall be provided by a single Manufacturer except as specifically noted herein:
   1. Amber-Booth.
   2. Mason Industries, Inc.
   3. Vibron.
   4. Kinetics.

2.2 VIBRATION ISOLATION EQUIPMENT

A. Isolation Pads:
   1. Isolator Type WP:
      a. Type WP (waffle pads) shall be 5/16-inch (8 mm) thick neoprene pads, ribbed or waffled on both sides. The pads shall be selected for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad. Neoprene shall be bridge-bearing quality with a maximum durometer (Shore A scale) of 50.
      b. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
      c. Type WP: Mason Industries Type W; or as approved by Engineer.
   2. Isolator Type MWP:
      a. Type MWP (metal and waffle sandwich pads) shall consist of two 5/16-inch (8 mm) thick ribbed or waffle neoprene pads sandwiching a 16 gage stainless or galvanized steel shim plate. The pad shall be designed for 15% strain. Neoprene shall be bridge-bearing quality with a maximum durometer (Shore A scale) of 50.
      b. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660, or as approved) shall be installed under the bolt head between the steel washer and the base plate.
      c. Type MWP: Mason Industries Type WSW; or as approved by Engineer.
   3. Isolator Type DDNM:
      a. Type DDNM (double deflection neoprene mounts) shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.
      b. The strain on the neoprene shall not exceed 15%. DDNM mounts shall be selected for a static deflection of 3/8-inch (9 mm) unless otherwise specified. Neoprene shall be bridge-bearing quality with a maximum durometer (Shore A scale) of 50.
      c. Type DDNM: Mason Industries Type ND; or as approved by Engineer.

4. Isolator Type RBA:
   a. Type RBA isolators shall be designed with a neoprene element to provide isolation in tension, shear or compression. Neoprene shall be bridge-bearing quality with a maximum durometer of 50.
   b. Type RBA: Mason Industries Type RBA; or as approved by Engineer.

B. Isolation Hangers:
1. Isolator Type DDNH:
   a. Type DDNH (double deflection neoprene hangers) shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene grommet extending from and continuous with the main neoprene element shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4-inch (19 mm) larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30-degree arc. When installed, the hanger box shall be allowed to rotate through a full 360 degrees without encountering any obstructions.
   b. Unless otherwise specified, the static deflection of DDNH hangers shall be 0.3 inches (8 mm) with a strain not exceeding 15%. Neoprene shall be bridge-bearing quality with a maximum durometer (Shore A scale) of 50.
   c. Type DDNH: Mason Industries Type HD; or as approved by Engineer.

C. Spring Isolators:
1. Isolator Type SPNM:
   a. Type SPNM (spring and neoprene mounts) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between 1 and 2. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection. Unless otherwise specified, the minimum static deflection of SPNM isolators for equipment mounted on grade slabs shall be 1-inch (25 mm), and the minimum static deflection for equipment mounted above the lowest level (i.e., not on a grade slab) shall be 2 inches (50 mm).
   b. Two Type WP isolation pads sandwiching a 16 gage stainless or galvanized steel separator plate shall be bonded to the isolator baseplate.
   c. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660; or as approved) shall be installed under the bolt head between the steel washer and the base plate.
   d. Type SPNM: Mason Industries Type SLFSW; or as approved by Engineer.
2. Isolator Type SPNH:
   a. Type SPNH (spring and neoprene hangers) shall consist of a steel spring in series with a neoprene isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches (8 mm) with a strain not exceeding 15%.
   b. Unless otherwise specified, the static deflection of SPNH hangers shall be 2 inches (50 mm). Neoprene shall be bridge-bearing quality with a maximum durometer of 50.
   c. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene grommet extending from and contiguous with the main neoprene element shall be provided where the hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger box. The diameter of the clear hole in the hanger box shall be at least 3/4-inch (19 mm) larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.
   d. Type SPNH: Mason Industries Type 30N; or as approved by Engineer.

3. Isolator Type CSNM:
   a. Type CSNM (constrained spring and neoprene mounts) shall be a spring and neoprene mount that incorporates a housing which includes vertical limit stops to prevent spring expansion when weight (water or other fluid) is removed from the equipment and limits the movement of equipment when it is subjected to wind loading. A minimum clearance of 1-inch (25 mm) shall be maintained around restraining bolts and between the housing and the spring, so as not to interfere with the spring operation. Limit stops shall be out of contact during normal operation, backed away from contact by at least 1/2-inch (12 mm); a neoprene washer shall be installed beneath the bolt head/washer used to restrain the isolator. In outdoor rooftop installations isolators must be bolted to the roof or supporting structure with a neoprene mounting sleeve.
   b. Unless otherwise specified, the minimum static deflection for Type CSNM mounts shall be 2 inches (50 mm).
   c. Type CSNM: Mason Industries Type SLR; or as pre-approved by Engineer.

D. Neoprene Mounting Sleeves: Neoprene mounting sleeves for hold-down applications of equipment with vibration isolators shall be Uniroyal Type 620/660; [or as pre-approved by Engineer].

E. Pipe Flexible Connectors:
   1. Isolator type PFC (pipe flexible connectors) shall be Kevlar-reinforced neoprene, single or double-sphere design. Flexible connectors with control rods will not be permitted.
   2. Type PFC: Mason Industries “Safelex” Type SFEJ or SFDEJ; [or as approved by Engineer.].

F. Riser Guide for Isolated Pipework: Riser guides for isolated pipes shall be type DDNM isolators bolted to the vertical edge of a 90 degree steel angle. The guide shall allow the pipe to move axially, but shall limit lateral movement to approximately 1-inch (25 mm).

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 2 inches (50 mm) between the bottom of the equipment or inertia base (and height-saving bracket) and the concrete housekeeping pad (or bolt heads, whichever is closest) beneath the equipment. The clearance shall be checked to ensure that no scraps have been left to short-circuit the vibration isolators. There shall be a minimum 4-inch (100 mm) clearance between isolated equipment and the walls, ceiling, floors, columns, and any other equipment not installed on vibration isolators.

B. Piping, conduit or plumbing equipment shall not be hung from or supported on other equipment, pipes, or ductwork installed on vibration isolators. It shall be supported on or suspended from building structure.

C. Equipment connected to fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping. Equipment should be blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims, and confirm that the isolators for the fluid-filled pipes, pumps, and other elements deflect the specified amounts and no more.

D. All plumbing equipment not specifically identified in this Specification that contains rotating or vibrating elements, and all associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM or RBA neoprene isolators as appropriate. In all such instances, submit the proposed isolators with the isolator Shop Drawings.

E. All isolators that are to be installed outdoors or exposed to the weather shall be hot-dipped galvanized and shall be furnished with neoprene mounting sleeves for hold-down bolts to prevent any metal-to-metal contact.

F. Elastomeric isolators that will be exposed to temperatures below 32 degrees F (0 degrees C), shall be fabricated from natural rubber instead of neoprene.

G. Wiring:
   1. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 36-inch (1 m) long flexible conduit in a 360-degree loop.
   2. All ties used to form the loop shall be removed prior to adjusting the isolators.

3.2 PUMPS

A. Inline Pumps:
   1. Inline pumps 1.5 hp (1.1 kW) and greater shall be supported by the piping which is isolated on Type SPNH isolators. If support is required below the pump, the pump shall be supported on Type SPNH or SPNM spring isolators as appropriate.
   2. Inline pumps less than 1.5 hp (1.1 kW) and adjacent pipework shall be supported on neoprene isolating hangers Type DDNH, unless other provisions of this Specification or the schedule call for greater deflection.

3.3 PIPE ISOLATION INSIDE THE MECHANICAL ROOM

A. Pipes Connected to Equipment on Spring Isolators:
   1. All pipes connected to equipment installed on spring vibration isolators shall be suspended, supported, and guided within the mechanical room for at least 30 feet by means of appropriate spring vibration isolators as described below. This includes, but is not necessarily limited to domestic water, hot water, pipes. The only exclusions are roof and floor drain and sprinkler piping. Pipes shall be supported by Type SPNM isolators or hung from the structure on Type SPNH isolators.
   2. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches (50 mm). The static deflection of the remaining pipe isolators shall be 1-inch (25 mm).

B. Pipes Connected to Equipment on Neoprene Isolators: Piping in the [mechanical room] that is connected only to machinery installed on neoprene isolators shall be either supported from the floor on Type DDNM mounts or suspended from the structure on Type DDHN hangers.

C. Pipes With Multiple Connections: Where a pipe run connects multiple items of equipment in the mechanical room, the pipe isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

D. A flexible connector shall be installed to connect a pipe on isolators to a piece of equipment on isolators of less static deflection than the pipe.

3.4 MISCELLANEOUS EQUIPMENT

A. Expansion Tanks and Water Heaters Without Pumps/Motors:
   1. Each floor-mounted unit shall be supported on Type MWP neoprene sandwich pads. Each suspended unit shall be supported on Type DDNH hangers. Where piping on isolators is connected to these units, the connection shall be made with a neoprene flexible connector.
   2. If an associated circulation pump is to be mounted on the unit and if the pumps is 0.5 hp (0.4 kW) or smaller, then the pump shall be mounted to the unit through Type RBA neoprene isolators. Such pumps larger than 0.5 hp (0.4 kW) shall be supported from the building structure on Type DDNM neoprene mounts or Type DDNH neoprene hangers. Pumps larger than 1.5 hp shall be supported on Type CIB concrete inertia bases which are supported on Type SPNM isolators. All connections to these circulation pumps shall be with flexible connections.

B. Drinking Fountains:
   1. Condenser/compressor units shall be mounted on Type DDNM isolators. Remote condenser/compressor units shall be mounted on Type DDNM isolators or suspended from building structure by DDNH isolators as appropriate.
   2. Drinking fountains with integral condenser/compressor units will not be permitted on noise-critical walls.

3.5 FIELD QUALITY

A. Work in accord with best trade practices, fabricate and install all items in accordance with Manufacturer's recommendations and Engineer's directions, and consult with trades doing adjoining work in order to provide an installation of first class quality.

3.6 ADJUSTMENT AND TESTING

A. Vibration Isolation Report:
   1. The vibration isolation Manufacturer shall inspect and approve the installation of the vibration isolators and shall submit a report to Engineer which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the Specification.
   2. The report shall record the model or type of each isolator.

B. Site Access: During installation of equipment, arrange for access as necessary for inspection of isolation and noise control equipment by Engineer.

C. Inspection:
   1. Upon completing installation and adjustment for suitable operation of all work specified under this Section, notify Engineer in writing, who will schedule a review.
   2. The Contractor's letter shall certify that all work specified under this Section is complete, operational, and adjusted in every respect, and that all work under this Section is ready for the completion checkout.
   3. For each inspection, workmen shall be furnished to perform such functions as are necessary for inspection of the equipment.
   4. Measurement of background noise levels by the Engineer requires that there be a minimum of extraneous noise.
   5. Such measurements must be scheduled during late-night hours when there is no work taking place on the site.
   6. Workmen shall be employed during the testing procedure to turn on and off all mechanical and electrical equipment for such background noise level testing.

END OF SECTION 22 05 46

SECTION 22 05 73 – TESTING AND CLEANING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes providing testing and cleaning services and the major items listed below:
   1. Provide all pumps, gages, valves and other equipment and material necessary to properly conduct tests and perform cleaning.
   2. Arrange and pay for all costs of utilities and chemicals required for the Work.
   3. Repair and Restore All Work Damaged:
      a. By tests.
      b. By cutting required in connection with the tests.

1.3 SUBMITTALS

A. Flushing and Cleaning:
   1. Submit certificates for all code-required inspections.
   2. Submit all water Sample analysis reports as required in Part 3 of these Specifications.

B. Pressure Test Reports:
   1. Submit within 1 week after each system pressure test.
   2. List time, date and persons present for the following for each system:
      a. Initial tests.
      b. Final test.
   3. Include report indicating:
      a. Test type and duration.
      b. Initial pressure.
      c. Final pressure.
   4. Indicate that necessary repairs and final tests were satisfactorily completed.

1.4 QUALITY ASSURANCE

A. Comply with all applicable codes.

B. Secure State Health Department approval for potable water systems.

C. Testing and Cleaning Agency:
   1. Minimum 15 years' experience in providing cleaning chemicals for water systems use.
   2. Provide regional laboratory support services.

PART 2 - PRODUCTS

2.1 CLEANING AGENT MANUFACTURERS

A. Aqua-Chem.

B. Aquatrol.

C. Enerco.

D. Nalco.

2.2 MATERIALS

A. Detergents, solvents and other cleaning agents shall be compatible with materials of fabrication of systems where they are used. No cleaning agent shall adversely affect materials or mechanisms in systems and cleaning agents shall be acceptable to equipment manufacturers and the plant environmental coordinator.

B. Detergents, solvents and other cleaning agents shall be compatible with process streams to be handled by systems in which the cleaning agents are used.

C. Owner will provide water for pipe cleaning and flushing. Other cleaning fluids, agents, and equipment shall be provided by Contractor.

D. Provide the necessary temporary equipment required for cleaning and flushing operations.

E. Provide permanent hose connections for supply, discharge and recirculating lines for the new piping system.

F. Provide piping at the ends of the main and branch lines of the piping system as required to accomplish flush of the piping.

G. Provide a temporary pump of sufficient head and GPM required to achieve a flushing velocity of at least 10 feet per second.

H. Provide temporary chemical skids with tote tanks as required for mixing chemicals and serving as a source reservoir and/or collection point for cleaning and flushing solutions.

I. Provide temporary bag filters (with filter bags) as required for removal of contaminants from flushing process.

J. Provide all hose, electrical leads and supply connections for completion of system required to fill, drain and refill of the lines utilizing plant supplied water and power.

PART 3 - EXECUTION

3.1 PIPING SYSTEM PRESSURE TEST

A. General:
   1. Perform all tests before piping is painted, covered, concealed or backfilled.
   2. Before testing, remove or otherwise protect from damage, control devices, air vents, fixtures, meters, or other parts which are not designated to withstand test pressures.

B. Test Procedures:
   1. Air Test:
      a. Charge with air to the test pressure specified.
      b. When possible, perform test when ambient air temperature is constant.
   2. Soap Test:
      a. Charge with air, water or carbon dioxide to pressure specified.
      b. Examine all joints for leaks with a soap suds solution.
   3. Water Test:
      a. Charge with water to the pressure specified.
      b. Exterior Surface of Pipe and Fittings:
         1) Show no cracks or other form of leaks.
         2) Completely drip dry.

C. Pressure Test Criteria:
1. Test criteria below are minimum requirements. In addition, the requirements of State and Local Codes having jurisdiction shall be met:

Piping System	Type Test	Pressure	Allowable Pressure Drop	Minimum Test Duration
Drainage System	Water	5 psig	0 psi	30 Minutes
Vent System	Water	5 psig	0 psi	30 Minutes
Water (Domestic)	Water	100 psig	0 psi	4 Hours
Gas *	*	*	*	*
*See below for natural gas piping pressure tests				

2. Natural Gas Piping:
   a. Test in accordance with NFPA 54, Sections 8.1.4.2 and 8.1.4.3.
   b. Test pressure to be used shall be no less than 1-1/2 times the proposed maximum working pressure, but not less than 3 psi.
   c. Where the test pressure exceeds 125 psi (862 kPa), the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe.
   d. Test duration shall be not less than 1/2 hour for each 500 cubic feet (14 cubic meter) of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet, the test duration shall be a minimum of 10 minutes. The duration of the test shall not be required to exceed 24 hours.

3.2 FLUSHING AND CLEANING PROCEDURES

A. Preinstallation Cleaning:
1. Before installation, unless otherwise specified, piping shall be cleaned as follows:
   a. Hammer, brush, scrub with soapy rags, to loosen sand, dirt, or scale when necessary. Remove excess grease and oil from exterior surface.
   b. Blow with air, or flush with clean water, and inspect before erection.
   c. Pipe cleaned and stored before installation shall be dried and ends sealed with a rigid plug or flange protector and tape.
   d. Physical cleaning procedures shall not damage materials or mar surfaces of such materials. Hammering shall not be used on cast iron, fiberglass-reinforced plastic, or plastic pipe.

B. Prior to Flushing:
1. Remove orifice plates, traps, strainer elements, flow control valves, prior to or during process of cleaning. Remove instruments which might be damaged by cleaning procedures. Replace such items with spool pieces, plugs, or blind flanges. A "blind list" shall be prepared listing where blinds have been installed for cleaning and shall be provided to Owner after cleaning is complete to verify that all blinds have been removed.
2. Items removed from piping system shall be cleaned separately.
3. Lock valves in open position.
4. Use new gaskets, thread lubricants when removed items are reinstalled after cleaning.
5. Temporary Strainers: Disconnect piping to be flushed from equipment or install temporary strainers immediately upstream of such equipment.

C. System Protection:
1. Protect piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during flushing and draining procedures.
2. Exercise special care with polyvinyl chloride (PVC) and fiberglass-reinforced plastic (FRP) piping and upon initial filling of long pipe runs to determine that pipe is in contact with hangers and supports before filling. Piping bowed out of hangers or supports will settle or lengthen during filling and resulting forces may be damaging at changes in direction.
3. Install high point vents and low point drains required to remove trapped air and to drain flushing liquid.

D. Domestic, Fire Protection and Other Open Water Piping Systems: Flush with clean water until all foreign matter is removed.

E. Remove and clean all strainers after flushing is complete.

F. Drain completely and refill after flushing.

G. Natural Gas Piping Systems:
   1. Blow clear using oil-free compressed air.
   2. Prior to pressure testing and final equipment connection.

3.3 POTABLE WATER PIPING DISINFECTION

A. Perform Domestic Hot Water system disinfection only after TAB engineer provides report (preliminary report is acceptable) showing full system balance.

B. Disinfect new or repaired potable water systems in accordance with the method prescribed by the local health authority or, in the absence of a prescribed method, in accordance with either AWWA C651 or AWWA C652 or in accordance with the current edition of the International Plumbing Code as described below. This requirement shall apply to “on Site” or “in-plant” fabrication of a system or to a modular portion of a system.

C. Flush the piping system with clean, potable water until dirty water does not appear at any of the points of outlet. Coordinate disposal of all flushing and disinfecting water with the plant environmental coordinator. Install temporary hoses as required to reach existing disposal points, or collect the water in a portable tote tank for transfer to the proper disposal location.

D. Fill the piping with a water/chlorine solution containing at least 50 parts per million (50mg/L) of chlorine, and the piping shall be valved off and allowed to stand for 24 hours; or the piping shall be filled with a water/chlorine solution containing at least 200 parts per million (50mg/L) of chlorine, and allowed to stand for 3 hours; after which the chlorine level shall be tested.

E. Following the required standing time and testing, flush the piping with clean potable water until the chlorine is purged from all parts of the system piping.

F. A bacteria test by an independent agency shall be performed, after the chlorine test has passed. Based on the result from the bacteria test, potable water shall be opened for service. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

G. Submit water Sample to State Health Department for test and approval.

END OF SECTION 22 05 73

SECTION 22 07 19 – PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of piping insulation.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Specifications:
      a. B209 – Aluminum and Aluminum Alloy Sheet and Plate.
      b. C534 – Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
      c. C547 – Mineral Fiber Preformed Pipe Insulation.
      d. C552 – Cellular Glass Block and Pipe Thermal Insulation.
   2. ASTM Standard Test Methods: E84 – Surface Burning Characteristics of Building Materials.
   3. National Fire Protection Association (NFPA) publications: NFPA 255 – Surface Burning Characteristics of Building Materials: 25, 50, 50 flame spread, fuel, smoke.
   4. ASHRAE:
      a. 90A – Energy Conservation in New Building Design, current edition.
      b. 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-rise Residential Buildings, with state amendments.

1.4 SUBMITTALS

A. Manufacturer's Literature: For piping insulation.
   1. For Each Type Used:
      a. Name of Manufacturer.
      b. Details of construction and installation.
      c. Manufacturer's data (density, K-factor).
   2. For Each Application:
      a. Thickness.
      b. Total "R" value.
      c. Jacket material.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable. Handle and store materials in a manner which will prevent deterioration and contamination with foreign matter.

B. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace removed materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Insulation:
1. Pittsburgh-Corning.
2. Owens-Corning.
3. Certainteed.
4. Armacell.
5. Rubatex.
6. Knauf.
7. Johns Manville.

B. Jacketing:
1. Ceel-Co.
2. O'Brien.
3. Zeston.
4. Childers.
5. Pabco.

C. Adhesives:
1. Benjamin Foster.
2. Childers.
3. Vimasco.
4. B.E.H.
5. Or equal.

2.2 TYPES OF INSULATION MATERIALS

A. Rigid Molded Glass Fiber – High Density (HFG):
1. All-service jacket (ASJ) type factory applied jacketing.
2. 6 lbs/cu ft minimum density.
3. k factor: See scheduled value listed in table herein.
4. 850 degree F service temperature.
5. Owens-Corning Type SSLII; or equal.
6. Typical for application on pipes below 16 inches.

B. Flexible Elastomeric Thermal Pipe Insulation (E):
1. Density of 5.0 lbs/cubic foot.
2. k factor: See scheduled value listed in table herein.
3. Maximum water vapor transmission of 0.17 per inch.
4. Must be listed for 25/50 flame/smoke spread for thickness used.
5. Armacell Armaflex AP; or equal.

2.3 PIPE AND FITTING COVERS

A. Polyvinyl Chloride (PVC) Covers:
1. Ultraviolet resistant.
2. 0.030-inch minimum thickness.
3. Preformed to match outer diameter of insulation.
4. Preformed fitting covers, minimum 10 mil.
5. Ceel-Tite 330; or equal, by Topline or Zeston.

B. Aluminum Covers (A):
1. ASTM B209, Alloy 3003 minimum.
2. 0.016-inch thickness.
3. Bright anodized or acrylic-coated smooth finish on exposed side.
4. 2-piece tee and ribless elbow covers in minimum 0.016-inch, preformed.

5. Provide moisture barrier backing and butt-joint with mastic seal for joining of adjacent sections.
6. Childers Products Company; or as approved.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install piping insulation:
   a. In conformance with the Drawings. these Specifications, and the Manufacturer's recommendations.
   b. After piping system has been satisfactorily tested.
   c. Over clean, dry piping system.
   d. To the following thickness:
      1) As specified herein or as indicated on the Drawings.
      2) If not specified herein or indicated on the Drawings, in accordance with Manufacturer's recommendations for the specific application.
   e. Continuous through walls, ceilings and sleeves except at fire stops.
2. Fill all cracks and voids with insulating cement carefully troweled to leave a smooth finish.
3. Repair or replace insulation damaged by:
   a. Demolition.
   b. Making connections to piping or equipment.
   c. Water or mildew.
4. Insulate bundles of pipes out-of-doors with complete wrap of insulation 1-1/2 inches thick and of suitable diameter to contain bundle, with outer wrap.
5. Pipe Sizes 12-inch and Larger: Hold each 3-foot section of insulation in place with at least 3 separate loops of No. 14 AWG stranded annealed wire.

B. Joints and Fittings:
1. Block insulate valves and flanges with reusable insulation system.
2. Insulate elbows, tube turns, sweeps and bends with mitered sections or premolded fittings. Match pipe covering material where used.
3. Fit joints tightly together.
4. Seal joints with sealing compound and preformed aluminum bands.

3.2 JACKETS AND FINISH

A. General:
1. Provide moisture barrier between the insulation and the jacketing in a continuous, unbroken seal.
2. Hold jacketing in place by a continuous sealed joint, providing a positive weatherproof seal along the entire length of the jacket.
3. Cap off ends with caps.
4. On cold lines, cut caps to the exact size of the pipe and seal with a recommended silicone calking.
5. Provide slip joints a minimum of every 25 feet or as needed for expansion.
6. Locate longitudinal jacket seams on indoor exposed piping out of view.

B. PVC:
1. Center a preformed strap (snap-strap) containing a permanently weatherproof plastic sealant over each circumferential joint and secure by tightening on a clip, or by use of a separate stainless steel banding.
2. Design snap-strap to take care of normal expansion.
3. Cover all pipe insulation and preformed insulation fittings.
4. Weld longitudinal seams together with welding adhesive as supplied by cover Manufacturer.
5. Overlap adjacent jacketing 3/4-inch and weld circumferential seams together with welding adhesive.
6. Overlap fitting covers to adjacent pipe insulation jacketing. Weld longitudinal and circumferential seams together with adhesive.

C. Attachment:
   1. For systems operating at 50 degrees F and above: May be stapled using outward clinch staples spaced 3 inches apart at least 1/4-inch from the lap edge.
   2. For systems operating below 50 degrees F: Vapor seal laps using self-sealing lap, lap seal tape gun or adhesive such as Benjamin Foster 85-60.

D. Taper and seal insulation ends regardless of service.

E. Fitting and pipe jackets to have matching finishes ready for painting.

F. For Insulation Without Factory Applied Jacket:
   1. Finish with 8-ounce glass mesh and mastic.
   2. Use breather mastic on piping operating at temperatures greater than 50 degrees F.

3.3 PIPING INSULATION APPLICATION SCHEDULE

A. Basis of Thickness Chart:
   1. Thicknesses shown are based on products having a maximum "k" factor at the mean temperature listed in table herein.
   2. These Thicknesses:
      a. Can be reduced for products having significantly lower "k" values.
      b. Shall be increased for products having higher "k" values in order to produce equivalent or greater thermal resistance.
      c. Changes in thicknesses shall be in accordance with ASHRAE 90.1.

B. Flame/Smoke Ratings: Local requirements for flame and smoke ratings must be met and may exclude some options listed herein.

C. Jackets and Finish Application:
   1. Provide PVC jacket on insulated exposed piping within 7 feet of the floor.
   2. Provide PVC jacket on insulated piping located outside.

D. Thickness Chart (In Inches):
   1. Key: Insulation Type (Refer to Paragraph 2.2 of this Section):
      a. HFG = High Density Rigid Fiberglass (Pipe sizes below 16-inch).
      b. E = Flexible Elastomeric.

					PIPE SIZE					
	Piping Systems Type	Temp (F) Range	Thermal Conductivity k (BTU·in / hr·ft·F degrees)	Mean Rating Temp (F)	Less Than 1″	1″ to <1-1/2″	1-1/2″ to < 4″	4″ to < 8”	8″ & Up	Type of Insulation *
1.	Domestic Hot Water	141-200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0	HFG, E
2.	Domestic Hot Water	105-140	0.22 – 0.28	100	1.0	1.0	1.5	1.5	1.5	HFG, E
3.	Miscellaneous	80-119			0.5	0.5	1.0	1.0	1.0	HFG, E
4.	Roof and Overflow Drainage**	--	--	--	--	--	1.0	1.0	1.0	HFG, E
5.	Domestic Cold Water/Non-Potable Cold Water	--	--	--	0.5	0.5	1.0	1.0	1.0	HFG, E
6.	Cooling Coil Drain	--	--	--	0.5	0.5	0.5	1.0	--	HFG, E

* See PART 2 – PRODUCTS Article 2.2 TYPES for types of insulation.
** Roof Drain Conductors, including roof drain sump, horizontal piping and first 2 feet of vertical pipe.

END OF SECTION 22 07 19

SECTION 22 10 00 – PLUMBING PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all materials, labor, equipment, supervision, fees, and services incidental to proper completion of all plumbing system work:
   1. Domestic cold water system.
   2. Domestic hot water system.
   3. Interior waste and vent piping to 5'-0" outside building.
   4. Interior storm drain piping and rain conductors to 5'-0" outside building.
   5. Cooling coil condensate drainage system.
   6. Domestic Water Supply:
      a. Arrange and pay for connection to municipal water service.
      b. Provide approved water meters and pay for all fees, permits, inspections, and tests relating to the water meter installation. Provide separate meter and valving for irrigation.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ANSI/ASME Standards:
      a. A112.19.2 – V.T. China Plumbing Fixtures.
      b. A112.1.2 – Air Gaps in Plumbing Systems.
      c. A112.21.1 – Floor Drains.
      d. A112.21.2 – Roof Drains.
      e. A112.36.2M – Cleanouts.
      f. A112.26.1 – Water Hammer Arresters.
   2. ASSE (American Society of Sanitary Engineering) Standards:
      a. 1001 – Pipe Applied Atmospheric Type Vacuum Breakers.
      b. 1003 – Water Pressure Reducing Valves.
      c. 1011 – Hose Connection Vacuum Breakers.
      d. 1012 – Backflow Preventers with Intermediate Atmospheric Vent.
      e. 1013 – Reduced Pressure Principal Backflow Preventer.
      f. 1016 – Individual Thermostatic Pressure Balancing, and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings.
      g. 1017 – Temperature Actuated Mixing Valves for Hot Water Distribution Systems.
      h. 1018 – Trap Seal Primer Valves – Potable Water Supplied.
      i. 1044 – Trap Seal Primer Valves – Drainage Type.
      j. 1072 – Performance Requirements for Barrier Type Trap Seal Protection for Floor Drains.
   3. ASTM Standards:
      a. A53 – Steel Pipe, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      b. A74 – Cast Iron Soil Pipe and Fittings.
      c. A181 – Carbon Steel Forgings for General Purpose Piping.
      d. A194 – Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
      e. A234 – Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
      f. A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      g. A395 – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
      h. A518 – Corrosion-Resistant High Silicon Iron Castings.
      i. B88 – Seamless Copper Water Tube.
      j. B306 – Copper Drainage Tube (DWV).

k. C76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
l. C564 – Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
m. D2136 – Test Method for Coated Fabrics – Low Temperature Bend Test.
n. D2657 – Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
o. D2665 – Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
p. D2751 – Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
q. D3034 – Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
r. D4101 – Propylene Plastic Injection and Extrusion Materials.
s. F789 – Type PS-46 and PS-115 Poly(Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.

4. AWWA Standards:
   a. C500 – Gate Valves for Water and Sewerage Systems.
   b. M20 – Water Chlorination Principles and Practices.
5. PDI (Plumbing and Drainage Institute) Standard: WH-201 – Water Hammer Arresters.
6. ARI Standard: 1010 – Drinking Fountains and Mechanically Refrigerated Drinking Water Coolers.
7. NSF/ANSI Standard 372 – Drinking Water System Components – Lead Content.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all products required in Part 2 of this Section:
   1. Required Information:
      a. General:
         1) Name of Manufacturer.
         2) Model number.
         3) Dimensions.
         4) Details of construction and installation.
      b. Performance Data:
         1) Heat transfer devices.
         2) Pumps.
   2. Not required for piping or hangers and supports.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Regulatory Agencies Requirements:
   1. All state and local codes and ordinances shall have jurisdiction.
   2. All related electrical devices shall be housed in suitable enclosures as defined by the National Electrical Manufacturers' Association (NEMA).
   3. All gas-fired appliances and installation shall be in accordance with American Gas Association (AGA) guidelines.
   4. All components used in systems in contact with drinking water shall comply with the requirements of NSF 372 for lead free.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Comply with the requirements of Division 22 Sections “Steel Pipe and Fittings for Plumbing,” “Cast Iron Pipe and Fittings for Plumbing,” “Plastic Pipe and Fittings for Plumbing,” and “Copper Pipe and Fittings for Plumbing.”

B. Refer to schedules in Part 3 of this Specification for specific applications of pipe materials to plumbing systems.

C. Refer to Division 22 Section “Hangers and Supports for Plumbing Piping and Equipment” and the schedule in Part 3 of this Section for Hanger and Support Requirements for Plumbing System Piping.

2.2 SPECIALTIES

A. Pipe Guides:
   1. Manufacturer:
      a. ITT Grinnell.
      b. Michigan Hanger.
      c. Keflex.
   2. Type: Spider, P-series, Figure 25L.
   3. Minimum 12 inches long.
   4. Spacing: As indicated on Drawings or as required by Expansion Joint Association.

B. Strainers:
   1. Manufacturer: Armstrong, Mueller.
   2. Type: "Y".
   3. Screen: 20 mesh brass, removable.
   4. Area: 5 times pipe diameter.
   5. Pressure Rating: Match piping.
   6. Install in front of each modulating valve, pressure regulating valve, pump suction and where indicated.

C. Basket Strainers:
   1. Manufacturer: Mueller Steam Specialty.
   2. Model: 125F.
   3. Cast iron body and cover, rated 200 psi W.O.G. with quick-release knobs and floor support.
   4. Basket: 0.057-inch perforated stainless steel (1/8-inch perforated on 5 inches and larger) removable with O-ring seal.
   5. Capacity: 6 to 1 open ratio.

D. Manual Air Vents:
   1. Manufacturer: Bell & Gossett or Dole.
   2. Size: 1/8-inch.
   3. Type: Slotted head (Bell & Gossett 4V or Dole No. 9).
   4. Location: Wherever called for on Drawings.

E. Shock Absorbers:
   1. Furnish and install where indicated or wherever quick closing valves (including flush valves) are utilized. Shock absorbers shall be located and sized in accordance with Standard PDI-WH-201.
   2. Manufacturer: Josam, Wade, or Zurn.

F. Dielectric Water Fittings:
   1. Dielectric Couplings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
   2. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered or flanged), which effectively isolates dissimilar metals, prevents galvanic actions and stops corrosion.

G. DWV Fitting Restraints
   1. Provide engineered fitting restraints on all no-hub DWV and storm pipe fittings greater than 4 inches. Pipe shall be restrained at all changes of pipe diameter greater than 2 pipe sizes and at all changes of direction with braces, blocks, rodding, or other suitable methods as specified by the coupling manufacturer.
   2. Provide engineered fitting restraints on all DWV and storm pipe no-hub fittings in buildings 2 stories and higher.
   3. Untested field provided restraints are unacceptable.
   4. Fitting restraints to be equal to HoldRite model #117 or similar.

2.3 VALVES

A. General Duty Hand Valves: Refer to Division 22 Section "General Duty Valves for Plumbing" for valve construction and material requirements.
   1. Valves Up to 2-inches:
      a. Shut-off: 150 lb bronze gate or full-port ball valve.
      b. Throttling: 150 lb bronze globe.
   2. Valves 2-1/2-inches and Larger:
      a. 125 lb IBBM OS&Y Gate Valve: Use only as required by local jurisdiction for water meter setting, all others shall be high performance all stainless-steel butterfly valves.
      b. Shut-off: High performance butterfly valve, all stainless steel, rated for 175 psig and 250 degrees F, bubble-tight shutoff, lug type.

B. Mixing Valves:
   1. ASSE 1070 Point of Use Thermostatic Control Valve:
      a. Certified for compliance with ASSE 1070 for individual fixture temperature control.
      b. Shall use a wax filled thermostatic element to sense incoming temperature fluctuations and maintain leaving water temperature 3 degrees F of setpoint for flows down to 0.5 gpm.
      c. Construction:
         1) Cast bronze body.
         2) Stainless steel internal components.
         3) 125 psig rated working pressure.
      d. Provide tamper resistant setpoint adjustment.
      e. Provide with integral check valves.
      f. Watts USG-B, Wilkin.

C. Water Pressure Regulators:
   1. Manufacturers:
      a. Cla-Val Company.
      b. Conbraco Industries, Inc.
      c. FLOMATIC Corporation.
      d. Honeywell Braukmann.
      e. Watts Industries, Inc.; Water Products Division.
      f. Zurn Industries, Inc.; Wilkins Division.
   2. General: ASSE 1003, water regulators, rated for initial working pressure of 200 psig minimum. Include integral factory installed or separate field installed, Y-pattern strainer:
      a. NPS 2 and Smaller: Bronze body with threaded ends.
         1) General Duty Service: Single seated, direct operated, unless otherwise indicated.
         2) Booster Heater Water Supply: Single seated, direct operated with integral bypass.
      b. NPS 2-1/2 and Larger: Bronze or cast iron body with flanged ends. Include AWWA C550 or FDA approved, interior epoxy coating for regulators with cast iron body:
         1) Type: Single seated, direct operated.
      c. Interior Components: Corrosion resistant materials.
      d. Exterior Finish: Polished chrome plate if used in chrome plated piping system.

D. Hose Bibb:
   1. Unit shall be freeze-proof, chrome finish with vacuum breaker, 3/4-inch hose thread nozzle cast integral, galvanized casing, key operated brass valve, flush mounting wall box. Select to interface with wall thickness. Mount 24 inches above grade.
   2. Manufacturer: Woodford Model B-67; or equal by Zurn, Wade Manufacturing Company, Prier, or Josam Manufacturing Company.

E. Floor Drain Trap Seals:
   1. For applications with infrequent drain usage:
      a. Provide inline drain trap seal, SureSeal Waterless Inline Drain Trap Seal. Green Drain Model GD Inline Drain Trap.
      b. Must comply with ASSE 1072.

2. Barrier-type:
   a. Installed in accordance with Manufacturer's instructions. Must comply with ASSE 1072.
   b. Manufacturer: Green Drain, IPS Corporation, Jay R, Smith, Rector Seal, Zurn.

2.4 BACKFLOW PREVENTER

A. Description:
1. Furnish and install approved backflow preventer(s) in accordance with the following table and as indicated on Drawings. Include a safewaste drain for drip from preventer valves piped to floor drain and install strainers ahead of first gate valve:

Service	Size	Rating	Description
HVAC Equipment	3/4" – 6"	175#	Reduced pressure principle double check/double gate with relief valve. Unit equal to Watts #909LF with strainer.
Domestic Water Services, Lawn Irrigation	3/4 – 8"	150#	Reduced pressure zone backflow preventer.
Vending Machines	3/4" – 3"	150#	Double check/double gate with intermediate vacuum breaker and relief valve. Unit equal to Watts #700.
Hose Bibbs	1/2" – 3/4"	150#	Single check with vacuum breaker equal to Watts #8 or #8A. Use #NF8 for frost proof hydrants
NOTE: Requirements of Codes having jurisdiction, that vary from the table requirements, shall be complied with for all services.			

B. Manufacturer: Watts, Hersey, Beeco, Febco, Conbraco.

2.5 CLEANOUTS

A. Description:
1. Furnish and install cleanouts where indicated on drawings in accordance with the following table. Cleanouts subject to vehicular traffic (hi-lo's, etc.) shall be heavy duty type.
2. Series floor cleanout with NH spigot outlet or ty-seal outlet connection, threaded adjustable housing, flanged ferrule with tapered brass plug and round or square nickel brass or ductile iron vandal resistant secured top for floor finishes

B. Manufacturer: Wade, Zurn, Josam, Smith, MI-FAB.

2.6 FLOOR DRAINS AND SINKS

A. Furnish and install floor drains at low point of sloped floor or at elevations indicated on the Drawings in accordance with the following.
1. Provide 4-inch deep seal traps on floor drains.

B. Description:
1. Floor Drains:
   a. FD-1: As scheduled on Drawings
   b. FD-2: As scheduled on Drawings
2. Floor Sinks (FS-1): (As scheduled on Drawings.

C. Manufacturer: Wade, Josam, Zurn, Smith, MI-FAB, Watts.

2.7 ROOF DRAINS

A. Description:
   1. Drain fittings shall be coated cast iron with flange, flashing rim, removable cast iron domed strainer, bearing pan, elastomerically gasketed outlet and deck clamps. Other specialty drains as called out on Drawings. Based on Zurn Z100 Series.
   2. Overflow drain(s):
      a. Shall be same size as roof drain with inlet floor line 2 inches above the low point of the roof.
      b. Overflow drains shall be connected to drain line independent from the roof drains.
      c. Roof drain shall be coated cast iron with 2-inch high plastic internal waterguard type, large cast iron interlocking dome, nonpuncturing clamp ring with integral stop, secondary flashing clamp with separate openings, bottom outlet, and large sump with wide roof flange and bottom outlet. Based on Zurn Z100 series.
      d. Contractor shall provide all miscellaneous steel for installation.
      e. Provide downspout nozzle (trim ring) for exterior of building. Based on Zurn 199 series.

B. Manufacturer: Wade, Josam, Zurn, Smith, MI-FAB, Watts.

2.8 GREASE INTERCEPTOR

A. Provide and install floor mounted grease interceptor as scheduled on Drawings,

B. Interceptor shall be tested and certified to the P.D.I. Standard PDI-G101 and also be marked.

C. Interceptor flow rate rated at 35 gpm and grease holding capacity of 130 pounds.

D. Grease Interceptor: Based on Schier Great Basin Series.

PART 3 - EXECUTION

3.1 WATER SUPPLY SERVICE SYSTEM

A. Description: Interconnect into water service main terminating 5'-0" outside building and extend into building as required. Furnish and install water meters of size indicated on the Drawings.

B. Fees, Permits, Inspection and Tests: Pay for all fees, permits, inspections, and tests related to the water meter installation.

C. Pipe and Fittings: In accordance with Schedule in Part 3.7 herein.

3.2 DOMESTIC COLD AND HOT WATER SYSTEMS

A. Description: Provide as indicated on the Drawings and as required to comply with all applicable codes and regulations, complete system of piping, fittings, valves, auxiliaries and accessories as required to connect cold and hot water to all items requiring cold or hot water.

B. Pipe and Fittings:
   1. Above Grade: Galvanized steel in accordance with Division 22 Section “Steel Pipe and Fittings for Plumbing” or Type L and drawn copper in accordance with ASTM B88 and Division 22 Section “Copper Pipe and Fittings for Plumbing” (maximum pressure of 75 psig). Exposed pipe and fittings at fixtures shall be chrome plated.
   2. Below Grade: Ductile iron in accordance with ANSI 16.9 A234 WPA Division 33 Section “Water Utilities” Type K soft temper copper in accordance with ASTM B88 and Division 22 Section “Copper Pipe and Fittings for Plumbing” (maximum pressure of 75 psig). or Schedule 80 CPVC in accordance with Division 22 Section “Plastic Pipe and Fittings for Plumbing.” (maximum pressure of 60 psig).
   3. Rolled grooved pipe may also be used for above grade installations of 2-1/2-inch and larger piping.

C. Installation:
   1. All interior piping shall be run square and straight with the building.
   2. Piping in finished areas shall be concealed within walls, chases, enclosures, etc.
   3. Piping in exposed areas shall be run as high as possible within joists and beam spaces, or below the floor as indicated on the Drawings.
   4. Piping shall follow approved paths as shown or indicated on the Drawings. Connect to existing lines where required or to equipment in an approved manner. Locate pipes, valves and equipment accessible for maintenance, minimum obstruction of passage and work spaces.
   5. Install drain valves at all low points in piping system.
   6. Install all required trap primer systems and piping.
   7. Provide unions at each screwed valve, unions, and at all points in the piping system where necessary to facilitate dismantling.

D. Hot Water Recirculation System:
   1. Where indicated, furnish and install hot and tempered recirculating water systems; return to the cold water side of the heater and provide a gate valve and union in each line. Special requirements as detailed on the Drawings.
   2. Provide supplemental angles, hangers and bracing required for the support of the equipment.
   3. Provide balancing valves on recirculating system return branches to allow complete balancing of all branches.

3.3 BUILDING STORM DRAINAGE SYSTEM

A. Description: Furnish and install the entire building storm drainage system as indicated on Drawings. System includes, but is not necessarily limited to, the following items: Rain leaders, conductors, roof drains, cleanouts and secondary overflow drains.

B. Materials:
   1. Piping as defined in Division 22 Sections “Cast Iron Pipe and Fittings for Plumbing” and “Plastic Pipe and Fittings for Plumbing” as listed in PART 3 of this Specification.
   2. Drains and cleanouts as defined in Part 2 of this Section.
   3. Insulation as defined in Division 22 Section “Plumbing Piping Insulation.”

C. Installation:
   1. System discharge run to Site sewers as indicated on Drawings.
   2. Provide cleanouts at the base of all stacks and in buried piping in accordance with Code requirements and as indicated on the Drawings.
   3. Install equipment and piping square with the building.
   4. Horizontal piping shall be run at a minimum slope of 1/8-inch per foot for pipes 3-inches and larger and 1/4-inch per foot for pipes smaller than 3-inch, unless otherwise indicated.
   5. Locate roof drains at low points of roof and as indicated on the Drawings.
   6. All changes in pipe size shall be made in the horizontal piping only.
   7. No expansion joints or offsets in horizontal piping are required where the distance from drain to vertical stack is less than 8 feet.
   8. Furnish and install stack base fittings at the base of each riser set on a concrete or brick base on firm soil. All vertical risers shall be supported at floor.
   9. Insulate roof sumps and connecting piping. Refer to Division 22 Section “Plumbing Piping Insulation.”
   10. Provide flashing flange and clamp device with 60 mil. PVC pan extending a minimum of 12 inches beyond tip of flashing ring with outer edges turned up on each roof drain.
   11. Provide no-hub fitting restraints on piping greater than 4 inches and in all buildings two stories and taller.

3.4 BUILDING SANITARY DRAINAGE SYSTEM

A. Description: Furnish and install the entire building sanitary drainage system as indicated on the Drawings. System includes, but is not necessarily limited to, the following items: Waste and vent piping for all plumbing, fixtures requiring same, floor drains, cleanouts.

B. Material:
   1. Above and below ground piping as defined in Part 2 of this Section.
   2. Drains and cleanouts as defined in Part 2 of this Section.

C. Installation:
   1. General runs of sanitary sewer are indicated on Drawings diagrammatically and every bend, offset, etc., is not necessarily indicated, all of which must be installed to properly drain all stacks, fixtures, vents, etc.
   2. Run horizontal waste lines at a minimum slope of 1/4-inch per foot for pipes less than 3 inches in diameter and 1/8-inch per foot for lines 3 inches and larger, unless indicated otherwise.
   3. Connections between mains and laterals shall be made with wyes and 1/8 bends.
   4. Changes in direction shall be with long radius ells except in stacks where sanitary tees and short radius 1/4 bends may be used in changes from horizontal to vertical.
   5. Flash all vent stacks at the roof.
   6. Cleanouts shall be installed where required by code and as indicated on the Drawings and specified herein. They shall be accessibly located, set flush with finish surface or finish grade, and shall be same nominal pipe size as line served, but no larger than 4 inches. Stainless steel flush cover plates required for wall accessed cleanouts.
   7. Cleanouts indicated for lines outside of building shall be installed with a Y connection and a 4 degree elbow extending to grade with bell set in concrete collar not less than 12 inches square and 12 inches thick.
   8. Provide cleanouts located in waterproof above grade floors with flashing flange and clamp device. Flash with 60 mil PVC membrane minimum 4-foot square.
   9. Furnish and install stack base fittings at the base of each riser set on a concrete or brick base on firm soil. All vertical risers shall be supported at floors.
   10. Pitch vent lines to gravity drain to waste pipe.
   11. Provide no-hub fitting restraints on piping greater than 4 inches and in all buildings 2 stories and taller.

3.5 COOLING COIL CONDENSATE DRAINAGE SYSTEM

A. Each above-the-ceiling cooling unit shall have its condensate collection pan piped to nearest sanitary drain riser.

B. Piping shall be trapped as indicated on Drawings and pitched 1/8-inch per foot minimum.

C. Pipe size to match drain pan connection.

D. Use Type L copper pipe and hangers where necessary as defined in this Section.

E. Insulation required for all condensate drain piping.

3.6 CONDENSATE FROM HIGH EFFICIENCY GAS FIRED APPLIANCES

A. Refer to specific manufacturer installation guidelines for all piping and installation requirements.

B. Piping from the appliance to condensate trap and from condensate trap to acid neutralization kit must be CPVC, high-temperature silicone tubing, galvanized, or stainless steel, and be free of leaks.
   1. Copper pipe, carbon steel/iron pipe or PVC pipe are not acceptable.

C. Piping from the acid neutralization kit to the floor drain may use PVC or CPVC piping in lieu of other types listed above.

3.7 CLEANING, TESTING, CHLORINATION

A. As piping material is erected, the inside of all piping shall be thoroughly cleaned of foreign material. Flush and test piping before operation in accordance with Division 22 Section “Testing and Cleaning of Plumbing Systems.”

B. On completion of the domestic water piping systems, chlorinate the system using methods acceptable to and approved by Engineer. Furnish all chlorine and chlorinating equipment.

C. After system chlorination is complete, submit water Samples to the governing health department for testing. Take Samples as directed by Engineer, and provide Engineer with a letter from the governing health department indicating test results.

3.8 SCHEDULES

Storm and Sanitary				
System	Schedule	Material	Specifications	Remarks
Underground				
Sanitary: Minimum size 3 inches unless noted otherwise				
	S.V.	C.I.	ASTM A74	Bell & Spigot with Elastomeric Gasket or Lead & Oakum
	S.V.	C.I.	ASTM C564, A888	No Hub with Heavy Duty Couplings
	DWV	PVC	ASTM F891 ASTM D2665	Socket type “Push on” joint with solvent 4-inch to 15-inch
Storm: Minimum Size 3 inches				
	S.V.	C.I.	ASTM A74	Bell & Spigot with (Elastomeric Compression Gasket)
	S.V.	C.I.	ASTM C564, A888	No Hub with Heavy Duty Couplings
	DWV	PVC	ASTM F891 ASTM D2665	“Push on” joint 4-inch to 15-inch
Above Ground				
Sanitary	S.V.	C.I.	ASTM A74	Bell & Spigot with Elastomeric Compressive Gasket. Lead & Oakum
	S.V.	C.I.	ASTM C564, A888	No Hub
	DWV	Copper	ASTM B306	ANSI B16.23 Soldered
	DWV	PVC	ASTM D2665	Size 2 inches or less Cement and Solvent
Storm				
	S.V.	C.I.	ASTM C564, A888	No HUB with heavy duty couplings

Domestic Water Above Ground 125 PSI Maximum Pressure					
Pipe Size	Schedule	Material	Spec	Grade	Remarks
1/4” – 1-1/2”	40	Steel Galvanized	ASTM A53	B	Threaded & Coupled
2” – 6”	40	Steel Galvanized	ASTM A53	B	Plain End
1/4" – 6”	Type L	Copper	ASTM B88	--	Solder 95/5, Silvabrite
2” – 6”	Type L	Copper	AWS A5.8	--	Silver Solder/Brazed

Domestic Water Below Ground				
Pipe Size	Schedule	Materials	Spec	Remarks
1/2" – 2”	Type K	Soft Copper	ASTM B88	Flared Fittings
2-1/2” – 12”	Class 52	Ductile Iron	ANSI 16.9 A234 WPA	ANSI A21.11 Mechanical Joint
1 – 4	80	CPVC	ASTM F438, D2846	Socket, solvent welded for use in corrosive soils only

END OF SECTION 22 10 00

SECTION 22 10 23 – NATURAL GAS PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of natural gas piping and related items:
   1. Natural gas transmission system.
   2. Natural gas distribution system.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ANSI Z223.1 – Fuel Gas Code.
   2. ASME B31.1 – Power Piping.
   3. ASME B31.8 – Gas Transmission and Distribution Piping Systems.
   4. International Fuel Gas Code, latest edition.
   5. NFPA 54, National Fuel Gas Code, Latest Edition.

1.4 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications: Trained and experienced in the fabrication and installation of the materials and equipment.

B. Installation shall comply with:
   1. State and local codes and ordinances.
   2. Requirements of:
      a. Owner's insurer.
      b. Gas distribution utility.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration and contamination with foreign matter.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace removed materials at no additional cost to Owner.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. During Freezing Weather:
   1. Protect all materials in such a manner that no harm can be done to:
      a. Installations already made.
      b. Materials and equipment on the Site.

F. Furnish all necessary protection for such installations and equipment as may be required.

PART 2 - PRODUCTS

2.1 PIPE AND FITTING APPLICATIONS:

A. General:
1. Comply with the requirements of Division 22 Section “Steel Pipe and Fittings for Plumbing.”
2. Pipe 6'-0" and longer shall be permanently marked with the following information:
a. Manufacturer's name.
b. Pressure rating.
c. Size.

B. Natural Gas – To 30 psig:
1. For Piping Through 2-Inch:
a. Pipe: Black Steel, Schedule 40, ASTM A53 or A106, seamless, Grade B.
1) Fittings: Cast Iron, ASTM EB16.4, 150 pound.
2) Joints: Screwed.
2. For Piping 2-1/2-Inch and Larger:
a. Pipe: Black Steel, Schedule 40, ASTM A53 or A106, seamless, Grade B.
1) Fittings: Schedule 40, Wrought Steel, ASTM B16.9, ASTM A234.
2) Joints: Welded. Flanged ASTM A181, 150 pound, forged steel at valves, and equipment.

C. Buried Piping (HDPE):
1. For Piping from 2-inch to 12-inch:
a. Pipe: High Density Polyethylene Pipe, SDR-11, ASTM D-2513.
1) Fittings: PE, ASTM D-2513, PE Transition to Steel, ASTM D2513 PE A53 Steel.
2) Joints: Butt Fused ASTM D-2513.
b. Tracer wire shall be installed which conforms to the International Fuel Gas Code, Latest Edition.
1) Tracer wire terminated in an accessible location.
c. Provided with yellow color or stripe.
2. Underground Warning Tape:
a. Minimum 3-inch wide polyethylene detectable type marking tape. The tape shall be resistant to alkalis, acids and other destructive agents found in soil and impregnated with metal so that it can be readily recognized by standard locating equipment.
1) Lamination bond of 1 layer minimum 0.35 mils thick aluminum foil between 2 layers of minimum 4.3 mils thick inert plastic film.
2) Minimum Tensile Strength: 63 lbs per 3-inch width.
3) Minimum Elongation: 500 percent.
4) Provide continuous yellow and black letter printed message repeated every 16 inches to 36 inches warning of pipe buried below (e.g.: “CAUTION GAS LINE BURIED BELOW”).
5) Reef Industries “Terra Tape”; or approved equal.
3. Transition Service-Line Risers:
a. Factory fabricated and leak tested.
b. Outlet shall be threaded, flanged or suitable for welded connection.
c. Bridging sleeve over mechanical coupling.
d. Factory-connected anode.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
h. Install in accordance with Manufacturer’s installation instructions.

D. Buried Piping (Steel):
1. Wrap with a pressure-sensitive, adhesive-backed, polyvinyl chloride or polyethylene tape:
a. Spirally wrap straight pipe with 0.020-inch thick tape with minimum overlap of 1/2-inch.
b. Spirally wrap 2 layers of 0.010-inch thick tape with minimum overlap of 1/2-inch.
c. Manufacturers: 3M Company “Scotchwrap.”
2. Steel pipe with a factory-applied polyethylene plastic coating such as Energy Coatings Company, “Pritec” may be used in lieu of wrapping specified above.

2.2 VALVES

A. Plug Valves:
   1. Aboveground:
      a. Plug valves (gas cock) for natural gas shutoff applications shall be lubricated type equal to Homestead Figure 611 or 612 or Rockwell Figure 114 or 115.
      b. Valves 2-inch and smaller shall be threaded. Valves 2-1/2-inch and larger shall be flanged.
   2. Underground (Curb Type):
      a. Plug valves (gas cock) for natural gas shutoff applications shall be lubricated type equal to Nordstrom Figure 1943 or 4185.
      b. Valves shall be welding end.
      c. Provide with adjustable tar coated cast iron extension shaft and flush box with extra heavy cast iron cover marked “GAS”. Provide 2 operating handles.

B. At the Contractor’s option, provide gas ball valves at equipment shut off locations where piping is 2 inches or smaller. Valves shall be by manufacturers listed in Division 22 Section “General Duty Valves for Plumbing” and be rated for natural gas service.

C. Valve Boxes:
   1. Cast iron, 2 section box.
   2. Top section with cover with “GAS” lettering.
   3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
   4. Adjustable cast iron extensions of length required for depth of bury.
   5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
   1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
   2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
   3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
   4. Corrugated stainless steel tubing with polymer coating.
   5. Operating Pressure Rating: 0.5 psig.
   6. End Fittings: Zinc coated steel.
   7. Threaded Ends: Comply with ASME B1.20.1.
   8. Maximum Length: 72 inches.

B. Quick Disconnect Devices: Comply with ANSI Z21.41.
   1. Copper alloy convenience outlet and matching plug connector.
   2. Nitrile seals.
   3. Hand operated with automatic shutoff when disconnected.
   4. For indoor or outdoor applications.
   5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 40 mesh startup strainer, and perforated stainless steel basket with 50% free area.
   4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast iron or malleable iron increaser fitting with corrosion resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded end connection.

2.4 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Actaris.
b. American Meter Company.
c. Eclipse Combustion Inc.
d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
e. Invensys.
f. Maxitrol Company.
g. Richards Industries; Jordan Valve Division.
2. Body and Diaphragm Case: Cast iron or die cast aluminum.
3. Springs: Zinc plated steel; interchangeable.
4. Diaphragm Plate: Zinc plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Untraviolet-stabilized, mineral filled nylon.
8. Single port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150% of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory installed or field installed, stainless steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Canadian Meter Company, Inc.
b. Eaton Corporation; Controls Division.
c. Harper Wyman Company.
d. Maxitrol Company.
e. SCP, Inc.
2. Body and Diaphragm Case: Die cast aluminum.
3. Springs: Zinc plated steel; interchangeable.
4. Diaphragm Plate: Zinc plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet stabilized, mineral filled nylon.
7. Factory Applied Finish: Minimum 3 layers polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

PART 3 - EXECUTION

3.1 NATURAL GAS DISTRIBUTION SYSTEM

A. Description of Work:
1. Provide complete natural gas distribution system as indicated on Drawings and as required to comply with applicable codes and regulations (0.5 inches pressure drop) at 2 psi with maximum 10% pressure drop.

2. This includes, but is not limited to, the following:
   a. Connect to gas meter installation.
   b. Vent lines to atmosphere where applicable.
   c. Connect gas to equipment outlets.
   d. Auxiliaries and accessories.
   e. Provide gas pressure regulators at appliances and equipment designed to operate at a lower pressure than the supply pressure and as indicated on Drawings. Regulators shall be listed as compliant with ANSI Z21.80 Standard for Line Pressure Regulators.

B. Aboveground and Indoor Piping and Installation:
   1. Install gas piping and valves in accordance with the requirements of the International Fuel Gas Code, the gas company, and the NFPA 54 National Fuel Gas Code.
   2. Run gas piping and make final connections to equipment requiring gas.
   3. Install gas cock and drip in branch laterals serving each piece of equipment.
   4. Gas pipe in inaccessible locations shall not have unions, valves, tubing fittings or running threads.
   5. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
   6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
   7. Locate valves for easy access.
   8. Install natural gas piping at uniform grade of 2% down toward drip and sediment traps.
   9. Install piping free of sags and bends.
   10. Verify final equipment locations for roughing-in.
   11. Drips and Sediment Traps: Install drips at points where condensate may collect, including service meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
      a. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
   12. Extend relief vent connections for service regulators, line regulators and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
   13. Connect branch piping from top or side of horizontal piping.
   14. Eccentric fittings or eccentric reducing couplings shall be used to make reductions. Install fittings with level side down.
   15. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
   16. Install strainer on inlet of each line pressure regulator and automatic or electrically operated valve.
   17. Install pressure gage upstream and downstream from each line regulator.

C. Connections:
   1. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas fired appliance and equipment. Install union between valve and appliances or equipment.
   2. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

D. Outdoor Underground Piping and Installation
   1. Comply with the International Fuel Gas Code, current edition, for installation and purging of natural gas piping.
   2. Install HDPE underground, natural gas piping buried 24 inches minimum cover below finished grade as required with a tracer wire terminated in an accessible location.
   3. Install fittings for changes in direction and branch connections.
   4. Install a continuous detectable warning tape on tamped backfill, 12 inches above buried non-metallic gas lines.
   5. Protect exterior underground pipe from damage due to heavy equipment traffic during construction.
   6. Do not install gas piping in the same trench with other utilities. The minimum horizontal clearance between gas pipe and parallel utility pipe shall be 2 feet. Do not install gas pipe through catch basins, vaults, manholes or similar underground structures.

END OF SECTION 22 10 23

SECTION 22 10 29 – PLUMBING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all materials, labor, equipment, supervision, fees, and services incidental to proper completion of all plumbing system pumps:
   1. Domestic cold water system.
   2. Domestic hot water system.
   3. Waste and vent piping.
   4. Storm drain piping and rain conductors.
   5. Cooling coil and steam condensate drainage system.
   6. Domestic water supply.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the ASHRAE 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, with state amendments.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all products required in Part 2 of this Section:
   1. Required Information:
      a. General:
         1) Name of Manufacturer.
         2) Model number.
         3) Dimensions.
         4) Details of construction and installation.
      b. Performance Data:
         1) Pumps.
      c. Project specific wiring diagrams including controls wiring.
      d. Control components

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Regulatory Agencies Requirements:
   1. All state and local codes and ordinances shall have jurisdiction.
   2. All related electrical devices shall be housed in suitable enclosures as defined by the National Electrical Manufacturers' Association (NEMA).
   3. All gas-fired appliances and installation shall be in accordance with American Gas Association (AGA) guidelines.
   4. All components in contact with drinking water shall comply with the requirements of NSF/ANSI 372 – Drinking Water System Components – Lead Content.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PUMPS

A. Manufacturers:
   1. Bell & Gossett.
   2. Grundfos.
   3. Amitrol.
   4. Syncroflo.
   5. Armstrong.

B. Domestic Hot Water Circulator:
   1. Circulator shall be in-line, flanged, all bronze, lead-free centrifugal pump equal to B&G Model NBF. Refer to Drawings for size and capacities.
   2. Provide with aquastat and automatic liner kit.
   3. Motor with built-in thermal overload protection.

C. Splash Pad Water Booster System:
   1. General:
      a. Furnish and install, as indicated on the Drawings and Specifications, a simplex booster system designed and based on the following:
         1) Total System Capacity: As indicated on the Drawings.
         2) Pump Boost Pressure: As indicated on the Drawings.
         3) Minimum Suction Pressure: As indicated on the Drawings.

2.2 MOTORS

A. Motors 1/3 HP and smaller shall be 120 volts, single phase. Motors 1/2 HP and larger shall be 208, 230, or 460 volts, 3 phase. Motors shall be size and rating as indicated on the drawing. Motors that are an integral part of special equipment may vary from above to meet manufacturing standards.

B. Motors shall be NEMA Design B, Class B, 1.15 S.F. at 40 degrees C ambient or 1.00 S.F. at 65 degrees C ambient.

C. Motors 1-1/2 HP and larger shall be cast iron heavy duty premium efficiency inverted rated T Frame.

D. Motors shall be grounded with manufacturer's supplied grounding kit.

E. All motors shall be ball bearing type. Ball bearings shall be sealed on both sides, manufactured be Fafnir, FAG, or SKF.

F. Motor enclosure shall be suitable for the service conditions.

G. Motors shall be Super-E manufactured by Baldor, EQP manufactured by Toshiba, or approved equal.

H. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

I. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

J. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of piping connections before installation.

3.2 INSTALLATION

A. Provide 4-inch housekeeping pad..

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Install vibration isolators on discharge of pumps.

3.4 FIELD QUALITY CONTROL

A. Perform Tests and Inspections:
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 START-UP SERVICE

A. Complete installation and start-up checks according to Manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by Manufacturer.

B. Adjust control setpoints.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 10 29

SECTION 22 36 00 – DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a packaged domestic water heater system.

1.3 REFERENCES

A. ASHRAE 90.1 – 2019 Energy Efficient Design of New Buildings Except for Low-Rise Residential Buildings, with state amendments.

1.4 SYSTEM DESCRIPTION

A. Package shall include atmospheric gas-fired heater, tank, piping, wiring, controls, pump, insulation, valves, temperature gage, pressure gage and relief valve.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Refer to the Drawings.

1.6 SUBMITTALS

A. Manufacturer's Literature: For complete assembly.
   1. Manufacturer's name and model number.
   2. Dimensions.
   3. Details of construction and installation.
   4. Performance data.
   5. Electrical characteristics.

B. Operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. A.G.A. approved and certified.

B. UL listed and approved.

C. ASME construction.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Gas or Electric:
   1. A.O. Smith.
   2. Rheem.
   3. Lochinvar.
   4. PVI Industries, Inc.
   5. Aerco.

6. Bradford White.
7. State.

2.2 DOMESTIC WATER HEATER – GAS

A. Heaters shall be completely factory assembled and include the following basic features:
   1. Glass-lined tank with magnesium anode and 3-year limited warranty against corrosion.
   2. Steel jacketed with baked enamel finish.
   3. ASME auto-reset type temperature/pressure relief valve.
   4. ASME constructed and labeled tank.

B. Gas water heaters shall include an A.G.A. certified burner equipped with safety shutoff, gas pressure regulator, intermittent pilot, high limit control, thermostatic burner control and integral automatic flue damper.

C. Electric Water Heaters:
   1. Outfitted with sheathed, medium watt density immersion elements, prewired and switched through magnetic contactors.
   2. Include manually resettable high temperature cutoff switch and separate 120 V control wiring circuit.

D. Heater shall meet ASHRAE 90.1 – 2019 requirements, with state amendments.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Manufacturer's instructions for the installation of water heaters.

B. Install water heaters with inlet and outlet gate valves, unions, di-electric fittings, relief valves piped full size to floor drains, and temperature gage on outlet water.

C. Where the floor at the installation site is uneven or where it will not support the weight of the boiler, construct a level concrete pad foundation according to the Manufacturer's erecting instructions or as indicated on the Drawings.

D. Factory-authorized service representative shall set and adjust burner and instruct Owner's representative in care and maintenance of unit.

E. Provide 1-year's free service from acceptance date with a factory-trained service representative subject to call 24 hours per day.

3.2 VACUUM RELIEF VALVE

A. Furnish and install on cold water supply to water heater when required by authority having jurisdiction or when water heater is mounted higher in elevation than the fixtures it serves.

B. Based on Watts No. N36; or equal.

3.3 VENTING

A. Refer to Division 23 Section "Breechings, Chimneys, and Stacks" for flue gas venting requirements.

B. Provide 1/2-inch IPS capped nipple welded to breeching and extending through insulation for flue gas sampling at each heater and coupling of size to receive draft gage and flue gas thermometer.

END OF SECTION 22 36 00

SECTION 22 40 00 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of plumbing fixtures.

B. Division of Work:
1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.
2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   a. General Contractor: Install or arrange for installation of all fixture supports and carriers as directed by mechanical Subcontractor.
   b. Mechanical Subcontractor:
      1) Furnish all required fixture supports and carriers.
      2) Instruct General Contractor regarding location and installation of supports and carriers.
      3) Be responsible for proper rough-in locations and dimensions.
   c. Faucet Manufacturer: Provides remote transformers for barrier free special trim.
   d. Electrical Subcontractor: Installs transformers for barrier free special trim.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
1. ANSI Standard:
   a. A112.18.1 – Finished and Rough Brass Plumbing Fixture Fittings.
   b. A112.19.2 – Vitreous China Plumbing Fixtures.
   c. A112.19.3 – Stainless Steel Plumbing Fixtures.
   d. A112.19.5 – Trim for Water Closet Bowls, Tanks & Urinals.
   e. A117.1 – Buildings and Facilities – Providing Accessibility and Usability for Physically Handicapped People.
   f. Z358.1 – Standard for Emergency Eyewash and Shower Equipment.
2. ARI – Air Conditioning and Refrigeration Institute – Standard: Drinking Fountains and Self-Contained, Mechanical Refrigerated Drinking Water Coolers.
3. ADA – Americans with Disabilities Act.
4. ASSE – American Society of Sanitary Engineering.

1.4 SUBMITTALS

A. Manufacturer's Literature: For fixtures.
1. Model number/name.
2. Manufacturer's name.
3. Dimensions.
4. Color/finish.

1.5 QUALITY ASSURANCE

A. Installing personnel shall be adequately trained and experienced in the installation of the materials and equipment.

B. Regulatory Requirements:
   1. Comply with 2021Michigan Plumbing Code.
   2. Installation shall comply with Americans with Disability Act (ADA) regarding type of fixtures and trim, height and clearance requirements, and safety components and systems.
   3. Comply with the State of Michigan barrier free design requirements as published by the Michigan Department of Labor Construction Code Commission.
   4. Comply with Americans for Disability Laws.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Fixtures: American Standard, Kohler, Elkay, Crane, Eljer, Haws, Just, Fiat, Ceco, Guardian.

B. Flush Valves: Sloan, Zurn, Delaney.

C. ADA Drain and Water Line Safety Covers at Lavatories and Sinks:
   1. Handy shield safety covers, Plumberex Specialty Products, Cathedral City, CA.
   2. Handi Lav-Guard, Truebro, Inc., Ellington, CT.

D. Faucets: Bradley, Moen, Zurn, Chicago Faucets, Delta.

E. Fixture Carriers: Wade, Josam, Zurn, Sioux Chief, Watts.

2.2 GENERAL

A. Traps:
   1. Equip fixtures with traps (with cleanouts) unless indicated otherwise, of the same size as the fixture connection.
   2. P-traps (above grade): Cast brass, adjustable, with a cleanout plug and 17 gage tubing outlet, chrome plated.
   3. Size branch lines as indicated.

B. Assemblies:
   1. Where fixtures are described by a Manufacturer's assembly number, furnish the complete assembly.
   2. Additional items not ordinarily furnished in the assembly will be indicated or noted.

C. Where roughing-in or installing fixtures and equipment furnished by other trades, provide required stops, supplies and traps, as well as rough-in, installation, and connecting work.

D. Finishes:
   1. Vitreous China Fixtures: White, unless specifically noted otherwise.
   2. Stainless Steel Fixtures: 20 gage minimum, Type 302, nickel bearing stainless steel, unless otherwise noted.
   3. Trim, fittings, traps, etc., where exposed to view: Heavy chrome plated.

2.3 WATER CLOSETS, URINALS AND LAVATORIES

A. Refer to the schedules on the Drawings for specific applications and the basis of design selections.

B. Fixture Carriers:
   1. Manufacturer: Wade, Zurn Josam, or Smith, Watts.
   2. Requirements:
      a. Secure wall mounted lavatories into position by means of carriers specifically manufactured for the fixture installed.
      b. Carriers shall be of proper size to fit within the space allotted.
   3. Supports: Provide adequate internal supports for wall mounting brackets.

C. Barrier Free Special Trim:
   1. Lavatory faucet activates water flow only when the user's hands enter infrared detection zone.
   2. Faucet turns itself off after the hands are removed from detection zones.
   3. Incoming water shall be tempered with thermostatic mixing valve.
   4. Tempered water shall not exceed 105 degrees F.
   5. Thermostatic mixing valve and solenoids shall be contained in recessed stainless steel No. 304, 18 gage cabinet, with 16 gage door and key.
   6. Barrier free lavatories shall have water supply tempered with an A.S.S.E. 1016 device.
   7. ADA approved drain and water safety covers are required on all exposed piping under barrier free lavatories.

2.4 SERVICE SINKS AND SINKS

A. Refer to schedules on the Drawings for specific applications and the basis of design selection.

B. If sink is ADA compliant or used for handwashing, incoming water shall be tempered with approved thermostatic mixing valve.

2.5 MISCELLANEOUS PLUMBING APPLIANCES

A. Refer to the schedules on the Drawings for specific applications and the basis of design selection.

B. Domestic water coolers.

C. Drinking fountains.

D. Hot water dispenser.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fixtures at proper heights in accordance with applicable codes and as indicated on the Drawings.

B. Point up around fixtures where they abut a wall or floor unless so directed by Engineer.

C. Securely fasten fixtures to the floor, wall, or counter. Fixtures shall be level and square.

D. Follow Manufacturer's instructions for fixture installations, especially for grouting and calking.

3.2 INSPECTION

A. Inspect each fixture and unit for damage to finish.

B. Remove and replace cracked, dented units and units or items unable to be repaired or restored to a condition acceptable to Engineer.

3.3 CLEANING

A. Thoroughly clean by washing with soap and disinfectant solution on all plumbing fixtures.

B. Remove, clean, and reinstall aerators.

END OF SECTION 22 40 00

SECTION 23 01 00 – OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Refer to individual Division 23 sections for additional equipment specific Operations and Maintenance Manual requirements.

1.2 SUMMARY

A. This Section includes preparing and furnishing an operating and maintenance manual for mechanical equipment.

1.3 DESCRIPTION

A. Compile an Operating and Maintenance Manual:
   1. For all building mechanical systems and major equipment items.
   2. Including, but not necessarily limited to:
      a. Installing company's name, address, telephone number and name of job supervisor.
      b. Maintenance and operating booklets (as supplied by the equipment Manufacturer) for each item or representative type item installed.
      c. Valve tag schedule.
      d. A complete set of Shop Drawings.
      e. Temperature control drawings.
      f. Equipment information forms for each equipment piece.
   3. Each equipment information form include all applicable items of the following:
      a. Type of unit.
      b. Manufacturer's name.
      c. Equipment service area.
      d. Filter Information:
         1) Filter change period.
         2) Type of filter.
         3) Size of filter and number.
      e. Motor and Drive Information:
         1) Belt type and quantity.
         2) Belt size.
         3) HP.
         4) Voltage.
         5) Phase.
      f. Lubrication Information:
         1) Recommended service interval.
         2) Lubricant application points.
         3) Recommended lubricant type.
      g. Recommended cleaning procedures and intervals.

B. Prepare Information Packets:
   1. Attach to each major piece of equipment in a string tie envelope labeled with the equipment's designation in large print.
   2. Information Required:
      a. A copy of the equipment information form as defined above.
      b. A temperature control written operation sequence.
      c. A maintenance checklist form with equipment identification information and listing all relevant maintenance procedures in a column format to accommodate date entries.

1.4 SUBMITTALS

A. Three hard copies of Operating and Maintenance Manual.

B. PDF Electronic File: Include a complete electronically linked operation and maintenance directory.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 23 01 00

SECTION 23 05 00 – GENERAL HVAC PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes specifying the general requirements for execution of that portion of the Work defined in Division 23 of these Specifications and as indicated on the Drawings:
   1. Major items include, but are not necessarily limited to:
      a. Cutting and patching.
      b. Concrete foundations and support steel.
      c. Piping, fittings and valves.
      d. Pump impeller trimming.
      e. Piping, ductwork and equipment insulation.
      f. Piping, ductwork and equipment painting.
      g. Temperature and pressure gages.
      h. Excavation and backfilling required.
      i. HVAC equipment, including drives.
      j. Ductwork.
      k. Temperature control systems.
      l. Demolition of existing mechanical work.
      m. Labor, materials, equipment, tools, supervision and start-up services.
      n. Mechanical systems testing, adjusting and balancing.
      o. Mechanical systems commissioning.
      p. Instructions to Owner regarding operation.
      q. Incidental and related items necessary to a complete and functionally operational installation of the Work.

B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the Work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the Work:
   1. General Contractor:
      a. Install access doors.
      b. Provide concrete isolation and housekeeping pads for mechanical equipment.
      c. Provide access doors in walls and ceilings for access to mechanical equipment.
   2. Mechanical Subcontractor:
      a. Furnish location, size and quantity of openings to Contractor before construction of new walls, ceilings, and floors.
      b. Furnish size and locations of concrete equipment isolation and housekeeping pads as required for this Work and as indicated on the Drawings to Contractor before slabs are poured.
      c. Furnish size and location of access doors required for this work as indicated on the Drawings to Contractor.
      d. Provide excavation and backfilling required in connection with the Work of Division 23.
      e. Provide miscellaneous structural steel required in connection with support of the Work of Division 23.
      f. Perform final cleaning of mechanical systems and equipment.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of Division 23 shall comply with the following:
   1. ANSI: A13.1 – Standard for the Identification of Piping Systems.

2. ASME – American Society of Mechanical Engineers:
   a. B31.1 – Power Piping.
   b. B31.9 – Building Services Piping.
   c. Boiler and Pressure Vessel Code:
      1) Section I.
      2) Section II.
      3) Section IV.
      4) Section VIII.
3. ASTM: A325 – Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
4. International:
   a. Building Code of 2021 including amendments.
   b. Mechanical Code 2021 including amendments.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Construction details, components, accessories, sizes and model numbers indicated on the Drawings or in these specifications are used to indicate minimum levels of quality and coordination requirements.

B. Design and layout, including clearances and service access, are based on Manufacturer, model and components as scheduled or otherwise indicated on the Drawings. Other listed approved Manufacturer's components and equipment are acceptable provided the following conditions are satisfied:
   1. Meet minimum requirements listed in specifications or on Drawings, be compatible with facility and intended use, and meet requirements for a functional system.
   2. Present to Engineer documentation verifying that all the above conditions are satisfied at least 10 days prior to bid receipt date.
   3. Meet all sound criteria as listed. Additional sound attenuation materials may be used if required.
   4. Coordinate and pay for all changes resulting from the use of alternate equipment and components:
      a. Coordinate and pay for all resulting work in other trades, including redesign efforts.
      b. Make all duct and piping system changes required in utilizing alternate equipment. Changes must reflect building conditions, ceiling spaces, chase sizes, structure locations.
      c. Obtain Engineer’s prior approval for all changes to layout, clearances, components and service access proposed.

C. Drawings:
   1. Are diagrammatic and indicate general arrangement of systems and work included.
   2. Do not necessarily indicate every required valve, fitting, trap, thermometer, gage, duct, elbow, transition, offset turning vane, mounting support and access panel.
   3. Shall not be scaled for measurement or installation location.
   4. Shall not serve as Shop Drawings.

D. Schedules and model numbers shall not be used to:
   1. Serve as final, definitive quantity requirements. Contractor shall make own count as indicated on Drawings.
   2. Determine proper type or model with arrangement, mounting and accessories applicable.

E. Coordinate installation work of Division 23 with work of other trades to provide a complete and functional system. Generally, the location of ductwork, sanitary, storm and vent piping take precedence over fire protection and HVAC piping, electrical conduit and cable trays.

1.5 SUBMITTALS

A. System Start-up Schedules:
   1. Submit 2 weeks prior to earliest proposed date.
   2. List time and date for the following for each system:
      a. Start-up.
      b. Demonstration.

B. Completion Reports:
   1. Submit within 1 week after each system demonstration.
   2. List time, date and persons present for the following for each system:
      a. Start-up.
      b. Demonstration.
   3. Include Manufacturer's representative's report indicating:
      a. Approval of installation.
      b. Satisfactory start-up.
      c. Functioning correctly.
   4. Indicate that demonstration and instructions were satisfactorily completed.

1.6 PRODUCT UNLOADING AND HANDLING

A. Unload equipment and materials required for completion of the Work.

B. Handle and store equipment and materials carefully to prevent damage. Method of rigging and handling shall be subject to the approval of an authorized representative of the equipment Manufacturer whose equipment is being handled.

1.7 TROUBLESHOOTING

A. By Contractor: If, during the start-up or warranty period, mechanical systems operational problems occur for which the root cause is not readily apparent, Contractor shall promptly, through a Subcontractor or other resource designated by Subcontractor, provide diagnostic and investigative services to determine the cause or causes.

B. By Engineer:
   1. At Contractor's request, Engineer will provide the services necessary to determine the cause or causes of the operational problems.
   2. Under the provisions of the General Conditions, Engineer will also provide these services if Contractor fails to respond satisfactorily to operational problems within a reasonable time after written notice from Engineer.
   3. If while working at Contractor's request or under the provisions of the General Conditions, Engineer determines that the problems are due to failure of the Work to comply with the requirements of the Contract Documents, Owner will compensate Engineer for additional services and deduct the amount paid from payment or payments to Contractor.

1.8 MAINTENANCE

A. Special Tools: Where special tools are required for operation, furnish these to Owner.

B. Loose and Detachable Parts:
   1. Retain loose and small detachable parts of the apparatus and equipment furnished until the completion of the Work.
   2. Turn over these parts to Owner.

C. Start-up Filters:
   1. Do not run air handling equipment without filters.
   2. Use of installed permanent heating and cooling equipment ductwork systems shall be in accordance with Division 01 Section “Temporary Facilities and Controls.”
   3. Provide temporary filters as required to protect the air handling systems during construction phase work.
   4. Just prior to Substantial Completion, replace temporary construction filter elements with the specified filter systems.

D. Construction Strainers:
   1. Remove after flushing and cleaning and prior to commencement of TAB.
   2. Attach removed construction strainer to piping where removed as proof of removal.

1.9 SUBSTITUTIONS

A. The Base Bid shall be based on equipment as specified. Where items are mentioned thusly, "may be furnished at the Contractor's option", the Contractor may use any one of the items named for their Base Bid. Proposals for substitutions are welcomed, but must be noted separately from the Base Bid and applied for in writing at Bid submittal.

B. Where the Contractor furnishes equipment or material specified as equal or which is accepted as a substitution, they are responsible for all modifications required for their work, and work of all other trades to install the equipment and ensure performance as originally specified.

C. Equipment and materials furnished as equal or as a substitution must be equal in quality, design, features, performances, arrangement, and appearance to that specified as standard.

PART 2 - PRODUCTS

2.1 FABRICATIONS

A. Miscellaneous Structural Steel:
   1. Comply with the requirements of Division 05 Section “Metal Fabrications,” where applicable.
   2. Structural steel work shall be done in accordance with the AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings, except that allowable stresses shall be reduced 25%.
   3. Where required, high strength structural steel bolting conforming to ASTM Specification A325 and assembled to AISC "Specifications for Assembly of Structural Joints. Using High Strength Steel Bolts" or welding shall be used in place of rivets.
   4. Connections shall be properly designed for the type of connection and the loads to be carried, and shall be subject to Engineer's or Owner's approval.
   5. Welding shall be done by operators who have been previously qualified by tests as prescribed in the American Welding Society "Standard Qualification Procedure" to perform the type of work required.
   6. Welding techniques shall conform to the American Welding Society "Code for Arc and Gas Welding in Building Construction", Section 4, Workmanship.
   7. Finished members shall be true to line and free from twist, bends and open joints.

B. Material installed in a ceiling plenum shall be either noncombustible or have a maximum flame spread of 25 and a maximum smoke developed rating of 50.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Character of Work: Installation shall be executed in a workmanlike manner and shall present a neat mechanical appearance when completed.

B. Laying Out of Work:
   1. Layout piping, ductwork, equipment and components in accordance with the Contract Documents and the Manufacturer’s recommended practice, including provision of adequate space for maintenance. Review layout with Engineer prior to installation.
   2. Check drawings of other trades to verify spaces in which work will be installed. Maintain maximum head room and space conditions at all points. Where head room or space conditions appear inadequate, notify Engineer before proceeding with installation.
   3. If directed by Engineer, Contractor shall make reasonable modifications in the layout as required to permit proper execution of the Work and to prevent conflict with work of other trades.
   4. Work shall be installed so as to be ready for operation, maintenance and repair. Minor deviations from Drawings may be made to accomplish this. Changes shall not be made without approval of Engineer.
   5. Unless indicated otherwise, install piping and ductwork concealed above ceilings or within walls.

3.2 PIPE FITTINGS

A. Provide insulating couplings or unions where dissimilar materials are joined.

B. Provide unions at valves and at equipment for making repairs.

C. Bull head connections in any piping service are expressly prohibited.

3.3 PAINTING

A. Paint exposed, insulated and non-insulated piping, ductwork and equipment.
   1. Surface Preparation:
      a. Comply with Steel Structures Paint Council Specifications.
      b. Remove rust and mill scale using power tool.
      c. Clean using power tool and water wash to remove weld spatter, flux and alkali contaminants.
   2. Application:
      a. One coat water base inhibitive metal primer.
      b. Two coats water base glass acrylic epoxy.
         1) 275 square feet per gallon minimum.
         2) Color: As selected by Owner.

B. Provide labels as specified below. Comply with OSHA “Safety Color Code for Marking Physical Hazards” and ANSI A13.1 for pipe labels and colors.

C. Valves, Fittings, and Supports:
   1. Paint valves and fittings the same base color as the pipe they adjoin.
   2. Paint floor stands the same base color as the pipe they adjoin.
   3. Paint exposed brackets, supports, framing members and pipe hangers the same base color as the adjacent wall, ceiling, floor or roof deck, or gray, if adjacent surface is not painted.

3.4 CODING AND TAGGING

A. Piping:
   1. Applied to new piping after installation, insulation, and final painting.
   2. Conform to Owner’s existing standards or conventions.
   3. Markings:
      a. Painted on, 1-inch high black letters.
      b. Color coded band, conforming to ANSI A13.1.
      c. Directional arrow.
   4. Place markers at 20-foot centers with at least 1 in each room and at each change in direction.
   5. Plastic coated "Set Mark-Snap-Around" pipe markers manufactured by Seton Name Plate Corp., New Haven, Connecticut; or approved equal, may be used in lieu of painted markers and bands.

B. Valves:
   1. Provide brass or minimum 1/16-inch thick laminated plastic tags indicating assigned valve number on valves.
   2. Furnish schedule(s) of tagged valves with number, location and purpose of each valve.
   3. Place a copy of each schedule:
      a. In the Maintenance Instructions.
      b. In a string tie envelope labeled "Valve Schedule" and mount on the wall in Mechanical Room.

C. Where valves, dampers, fans, and terminal units are located above the ceilings, a cadmium plated screw or such marking as designed by Engineer shall be located in the ceiling tile directly below the device.

D. Provide record documentation of all hydronic system air vent locations on record drawings (as-builts) or other method as approved by Engineer.

E. Equipment:
   1. Provide for:
      a. Each boiler, pump, rooftop unit and exhaust fan.
      b. Labeled with its tag name/number as given on the Drawings.
      c. Use 2-inch high stenciled painted lettering.
   2. Similarly label control components associated with the above named equipment items.

F. Dampers:
   1. Provide tag for each auto control damper, fire damper, combination fire/smoke damper, and smoke damper.
   2. Label shall bear the tag name and number as indicated on the Drawings.
   3. Use 2-inch high stenciled black lettering.
   4. At balancing dampers, mark position after final adjustment.

3.5 START-UP

A. Comply with the requirements of Division 01 Section “Starting and Adjusting.”

3.6 ADJUSTING

A. Adjust and align equipment for smooth operation:
   1. Plumb true and with parts in proper position and alignment.
   2. Rotating parts shall turn freely and in the correct direction.
   3. Flexible couplings shall be checked for alignment subject to Owner's approval.
   4. Follow Manufacturer's instructions.

B. The work of installation shall be executed in conformity with the best practice, so as to contribute to efficiency of operation, minimum noise or vibration, minimum maintenance, accessibility and sightlines.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:
   1. Provide when required by individual Section.
   2. Provide the following services except where indicated otherwise in individual Sections:
      a. Inspect, check and approve system installation.
      b. Supervise system start-up.
      c. Provide written report indicating that system:
         1) Has been properly installed and lubricated.
         2) Is in accurate alignment.
         3) Is free from undue stress imposed by connecting lines or anchor bolts.
         4) Has been satisfactorily operated under full load conditions.
      d. Demonstrate operation of system to Owner's personnel.
      e. Instruct Owner's personnel on operation and maintenance of system.

B. Performance Test:
   1. Test the entire Work, including all of its individual systems for 2 weeks before final payment will be made.
   2. Every phase of plumbing, air conditioning and heating and ventilating plant shall be operated separately, or in conjunction one with the other to demonstrate to Engineer the ability of the plant to meet capacity and performance requirements while maintaining design condition, in accordance with the true intent and purpose of these Specifications.
   3. Make final tests in the presence of Owner and Engineer.
   4. If a part of the Work or equipment does not meet Specifications:
      a. Correct the situation.
      b. Obtain approval of Engineer before final payment is made.
   5. Provide the personnel and bear costs for correcting malfunctions.
   6. Owner will provide operating personnel and utilities.
   7. Air and hydronic systems balancing shall be completed prior to performance testing.

C. Comply with the requirements of Division 01 Section “Starting and Adjusting.”

3.8 CLEANING AND FINISHING

A. Comply with the requirements of Division 01 Section “Cleaning and Waste Management.”

B. Entire installation shall be free from surface oil and grease before work will be considered for final payment.

C. After tests have been made and the system pronounced tight:
   1. Clean piping and equipment.
   2. Lubricate bearings.

D. Final cleaning includes but is not limited to the following:
   1. Equipment with Factory Finishes:
      a. Wash factory-finished equipment with mild soap and water and leave in first-class condition, entirely free of stains or streaks.
      b. Do not use abrasive materials.
      c. Touch up scratches or other violations of the factory finish paint with matching paint from the equipment Manufacturer.

END OF SECTION 23 05 00

SECTION 23 05 03 – STEEL PIPE AND FITTINGS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of steel pipe and fittings.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. American Society of Mechanical Engineers (ASME) Standards:
      a. B16.3 – Malleable Iron Threaded Fittings.
      b. B16.4 – Cast-Iron Threaded Fittings, Class 125 and 250.
      c. B16.5 – Pipe Flanges and Flanged Fittings, Steel Nickel Alloys and Other Special Alloys.
      d. B16.9 – Factory-Made Wrought Steel Buttwelding Fittings.
      e. B16.11 – Forged Steel Fittings, Socket Welding and Threaded.
      f. B16.21 – Nonmetallic Flat Gasket for Pipe Flanges.
      g. B18.2.1 – Square and Hex Bolts and Screws, Inch Series.
      h. B18.2.2 – Square and Hex Nuts.
      i. B31.1 – Power Piping.
      j. B31.9 – Building Services Piping.
   2. ASME publications:
      a. Boiler and Pressure Vessel Code.
      b. Power Boiler Code.
      c. Heating Boiler Code.
   3. ASTM Standards:
      a. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      b. A105 – Forgings, Carbon Steel, for Piping Components.
      c. A106 – Seamless Carbon Steel Pipe for High-Temperature Service.
      d. A126 – Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      e. A181 – Forgings, Carbon Steel for General Purpose Piping.
      f. A182 – Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings and Valves for High Temperature Service.
      g. A193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
      h. A194 – Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
      i. A197 – Cupola Malleable Iron.
      j. A234 – Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
      k. A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      l. A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile.
      m. A312 – Seamless and Welded Austenitic Stainless Steel Pipe.
      n. A395 – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

1.4 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Labeling: Piping materials shall bear the label, stamp or other marking of all specified standards and testing compliance, visible on the outside of the bare pipe

C. Testing of Steel Piping: In accordance with Division 23 Section “Testing and Cleaning of HVAC Systems.”

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
1. Except as herein specified or as indicated on the Drawings, all materials shall be in accordance with the Piping Systems Schedule in Part 3 of the appropriate applicable specification section.
2. Pipe 6'-0" and longer shall be permanently marked, visible on the outside of the bare pipe, with the following information:
   a. Manufacturer's name.
   b. Pressure rating.
   c. Standards met.
   d. Size.
3. Unless indicated otherwise in application sections of these specifications, all pipe joints shall be welded for pipe sizes 2-1/2 inches and larger.

B. Black Steel Pipe:
1. Black steel pipe shall be welded or seamless carbon steel, as specified for the type of service.
2. Welded black steel pipe shall meet the requirements of ASTM A53 or A106, and shall be Type F continuous-weld furnace butt-welding (CW), or Type E electric resistance welded (ERW) Grade B.
3. Seamless black steel pipe shall meet the requirements of ASTM A53 or A106, Type S seamless, Grade A or B.

C. Galvanized Steel Pipe:
1. Galvanized steel pipe shall be hot-dipped galvanized on inside and outside surfaces and shall meet the requirements of ASTM A53.
2. Zinc used in galvanizing shall meet the requirements of ASTM and shall be applied using 2 ounces of zinc per square foot of coated surface.

D. Stainless Steel Pipe and Fittings:
1. Stainless steel pipes 2 inches in size and smaller shall meet the requirements of ASTM A312, Schedule 40, seamless, Type 304 seamless pipe with ASTM A182, Grade F304, 150 psi socket-weld fittings.
2. Use 150 psi socket-weld, stainless steel ground joint unions.

E. Stainless Steel Tubing and Fittings:
1. Distribution Piping: ASTM A269, Type 315 stainless steel:
   a. 1/2-inch OD; minimum 0.035-inch wall thickness.
   b. 3/4-inch OD; minimum 0.049-inch wall thickness.
2. Fittings and Manifolds:
   a. Welded.
   b. Compression, Swagelok; or equal.
3. Minimum 15,000 psi rating.

F. Buried Piping:
1. Wrap with a pressure sensitive, adhesive backed, polyvinyl chloride or polyethylene tape:
   a. Spirally wrap straight pipe with 0.020-inch thick tape with minimum overlap of 1/2-inch.
   b. Spirally wrap 2 layers of 0.010-inch thick tape with minimum overlap of 1/2-inch.
   c. Manufacturers: 3M Company “Scotchwrap”; or approved equal.
2. Steel pipe with a factory applied polyethylene plastic coating such as Energy Coatings Company, “Pritec” may be used in lieu of wrapping specified above.

2.2 FITTINGS

A. Unions:
1. Pipe Sizes 2 Inches and Smaller:
a. Forged steel with ground joint.
b. Properly fitted for design temperature and pressure.
c. 2,000-pound rated equal to Crane No. 250H or 251H.
d. 3,000-pound rated equal to Crane No. 252H.
2. Pipe Sizes 2-1/2 Inches and Greater: Use companion flanges where unions are required.

B. Tapped Bosses:
1. Permitted in pipes and fittings.
2. 1-1/2-inch maximum hole size.
3. Boss Construction:
a. Weld material built up to a thickness 50% greater than required threads.
b. Forged bosses as approved by Owner.
c. 300-pound rated half couplings welded to pipe permitted for instrument connections 3/4-inch or smaller.

C. Screwed Fittings:
1. Cast iron in accordance with ASMEI B16.4.
2. Nodular or ductile iron in accordance with ASTM A395.
3. Forged steel in accordance with ASTM A181.
4. Schedule 80 fittings shall be used with Schedule 80 pipe.

D. Welding Fittings:
1. Meet ASTM A 234 symbol WPA or WPB.
2. The A or B grade shall conform to the grade of pipe used with the fittings.
3. Dimensional standards shall conform to ASME B16.9.
4. Schedule 80 fittings shall be used with Schedule 80 pipe.

E. Flanges:
1. General:
a. Welding neck or slip-on type with raised face.
b. Conforming to ASME B16.5.
c. Class 150 and 300 conforming to ASTM A181, Grade I.
d. Class 600 and 900 conforming to ASTM A105, Grade II.
2. Use threaded or socket weld type for piping smaller than 2-1/2 inches.
3. Use flat face steel flanges when matching cast iron companion flanges.

F. Flange Gaskets:
1. Non-asbestos compressed material conforming to ASME B16.21 and suitable for 600 degrees F service.
2. Ring type, 1/16-inch thickness.
3. Spiral wound stainless steel for service over 300 psi.
4. Use full face gaskets with flat face flanges.

G. Bolting Material:
1. General:
a. Carbon steel, square-head bolts and Grade 2H hex nuts.
b. Bolt length shall be sufficient to extend completely through nut with maximum 3/8-inch projection.
c. Dimensions conforming to ASME B18.2 (bolts) and ASTM A194 (nuts).
2. Bolts:
a. For service below 250 psig/450 degrees F, use Grade B conforming to ASTM A307.
b. For service at or above 250 psig/450 degrees F, use Grade B7 conforming to ASTM A193.

H. Socket Welding Fittings: All forged steel socket-welding fittings shall conform to ASME Standard B16.11 ASTM A105 Gr. II, equal to Crane 3,000-pound forged fittings.

2.3 GROOVED PIPING SYSTEMS

A. Grooved piping systems are NOT acceptable.

PART 3 - EXECUTION

3.1 PREPARATION

A. During Freezing Weather:
   1. Protect all materials in such a manner that no harm can be done to:
      a. Installations already made.
      b. Materials and equipment on the Site.
   2. Furnish all necessary protection for such installations and equipment as may be required.

3.2 ERECTION

A. General:
   1. All Piping: Follow approved paths as indicated on the Drawings.
   2. Connect to existing lines where required, or to equipment in an approved manner.
   3. Locate Pipes, Valves and Equipment to Provide:
      a. Access for maintenance.
      b. Minimum obstruction of passageways and working space.
   4. Normally, all pipe runs shall be plumb, parallel with the building and level, except for drain slope.
   5. Be responsible for establishing and maintaining drain slope of piping in order to ensure drainage.
   6. Expansion of Piping:
      a. All pipe connections shall provide freedom of movement of the piping during expansion and contraction without springing of piping or injury to building steel or structure.
      b. Any damage to building steel or structure as a result of work installed by Contractor shall be repaired at Contractor's expense.
   7. As Piping Material is Erected:
      a. Thoroughly clean the inside of all piping.
      b. Remove foreign material such as scale, sand, weld spatter, particles and cutting chips.
   8. Provide caps or plugs in all openings at the end of each day's work and as otherwise directed for the protection of the piping. Particular attention must be given to avoid the possibility of any foreign material entering the pipes.
   9. Flanges shall be made on pipe so that the gasket surface forms an angle of 90 degrees with the pipe axis. Screwed flanges shall be made on until the pipe projects through the flanges and then the flanges must be refaced.

B. Sleeves and Holes:
   1. Contractor shall be responsible for cutting required holes and openings in floors, walls and other structures, except as noted on the Drawings. Sleeves will be placed by Contractor in all such openings, and no holes shall be cut without Owner's approval. Sleeves shall be in accordance with the standard details included in the Drawings.
   2. All holes in floors, walls, roofs, etc., where pipe lines or other materials have been removed or installed, shall be neatly and properly filled with concrete, brick or other material in accordance with the general character of the construction at the location.

C. Unions and Eccentric Fittings:
   1. Unions shall be provided at each screwed valve and where their use will facilitate dismantling of the piping and as required or directed in special cases.
   2. Eccentric fittings or eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur in the main due to the reduction in pipe size.
   3. All reducing fittings used at pump inlets shall be eccentric and flush on the top for hydronic piping.
   4. Eccentric fittings shall keep the pipes flush on the bottom for steam and condensate piping.

D. Pipe Joints:
   1. Pipe connections at all valves shall be mechanically joined unless otherwise indicated on the Drawings or reviewed by Owner or Engineer.
   2. Pipe joints which will be buried or otherwise concealed shall be welded regardless of size.
   3. Mitered joints shall not be permitted.
   4. In general, black steel 2-1/2-inch and larger shall be welded except that a flange or union shall be provided at all valves and at equipment.
   5. The connections to welded 2-1/2-inch and larger pipe shall be made with a welding tee or Weld-o-let of butt, socket or threaded type as required. Scarf welding of side connections shall not be permitted.
   6. Only welding ells shall be used for changing pipe directions of welded pipe lines.

3.3 WELDING

A. All Pipe Welding:
   1. Where welding is called for, it shall be of the fusion process and shall consist of welding by means of either the oxyacetylene or electric arc process.
   2. The pipe assembly at orifice and flow nozzle locations shall be left unassembled until inspected and approved by Owner or Engineer.
   3. All welding shall conform to the ASME Boiler and Pressure Vessel Code or the ASME Code for Pressure Piping. All welders shall be qualified in accordance with ASME Standard Qualifications for Welding Procedures, Welders and Welding Operators, or Section 9 of the ASME Boiler and Pressure Vessel Code for the class of piping being welded. Submit welding qualifications for all welders on the Project when requested by Engineer.
   4. No welding to building work shall be allowed without approval of Engineer.
   5. Black steel piping may be welded with chill rings in lieu of that specified.
   6. Mitered turns will not be allowed. Turns shall be made with welded type fittings.
   7. Branch take-offs with manufactured formed nipples will be permitted, if not restricted by code, and where nipple size is at least two pipe sizes smaller than the main size. Formed nipples shall be Bonney Forge “Weldolets”, “Threadolets”, “Sockolets.”

3.4 ADJUSTING AND CLEANING

A. Clean and test piping in accordance with Division 23 Section “Testing and Cleaning of HVAC Systems.”

END OF SECTION 23 05 03

SECTION 23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all electric motors required for Division 23 specified equipment.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. NEMA – National Electrical Manufacturers Association – Standards and publications governing the following performance criteria:
      a. Frame design.
      b. Torque.
      c. Enclosures.
      d. Dimensions.
      e. Power supply and voltages.
      f. Locked rotor KVA per horsepower.
      g. Service factor.
      h. Sound power levels.
   2. NFPA 70 – National Electrical Code.
   3. ASHRAE 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, with state amendments.

1.4 SUBMITTALS

A. Manufacturer's Literature:
   1. All polyphase motors.
   2. All motors 3 horsepower (name plate) and larger.
   3. All Motors:
      a. Name and manufacturer.
      b. Type and model.
      c. Rated size.
      d. Type of bearings.
      e. Weight.
      f. AFBMA Rating
   4. Lubrication and maintenance instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of electric motors and their accessories, with minimum 3 years documented product development, testing, and manufacturing experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored onsite from weather and moisture by maintaining factory covers and suitable weatherproof covering.

B. For extended outdoor storage, remove motors from equipment and store separately in a protected area.

1.7 WARRANTY

A. Provide 2 year Manufacturer's warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Reliance.

B. Magnetek.

C. Baldor.

D. Lincoln Electric.

E. Subject to compliance with specifications, motors drawing less than 250 watts and intended for intermittent service may be supplied by an alternate Manufacturer commonly used by the equipment Manufacturer.

2.2 SPEED (EXCEPT WHERE NOTED OTHERWISE)

A. 1,800 rpm.

B. Variable speed.

2.3 CONSTRUCTION

A. Designed for continuous operation in 40 degree C environment, Class B insulation. Motors interconnected with a variable frequency drive shall be provided with Class F insulation and shall be inverter duty rated, and shall be outfitted with shaft grounding kit or isolated bearings.

B. All copper windings with a minimum service factor of 1.15 for totally enclosed, fan-cooled (TEFC) and 1.25 for open, drip-proof (ODP) motors.

C. NEMA frame, arrangement, and design as required for the specific application.

D. Permanently lubricated unless specifically noted otherwise.

E. Comply with all requirements for UL approval and labeling for specific hazard classification where explosion-proof and severe duty motors are indicated.

F. Provide a visible stainless steel nameplate indicating:
   1. Motor horsepower.
   2. Voltage.
   3. Phase.
   4. Cycles.
   5. RPM.
   6. Full load amps.
   7. Locked rotor amps.
   8. Frame size.
   9. Manufacturer's name and model number.
   10. Service factor.
   11. Power factor.
   12. Efficiency: Nameplate motor efficiency shall be identified in accordance with NEMA and ASHRAE 90.1 standards.

G. Except as specifically noted, all motors shall be high efficiency as listed in ASHRAE 90.1 for all motors 1 horsepower and larger: All efficiency ratings are to be as tested in accordance with IEEE Spec. 112, Method B.

H. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

I. Variable frequency drive units and motors shall be matched for proper operating characteristics.

2.4 VOLTAGE AND MOTOR TYPE

A. Special conditions and voltage are noted on the Drawings.

B. Electronically Commutated (EC) Motor:
1. Specifically designed for fan applications.
2. Permanently lubricated with heavy duty ball bearings to match fan load and prewired to specific voltage and phase.
3. Internal motor circuitry shall convert AC power supplied to fan to DC power for motor operation.
4. Speed controllable down to 20% of full speed (80% turndown).
5. Minimum 85% efficient at all speeds

C. Single Phase Power – Split Phase Motors:
1. Starting Torque: Less than 150% of full load torque.
2. Starting Current: Up to 7 times full load current.
3. Breakdown Torque: Approximately 200% of full load torque.

D. Single Phase Power – Permanent-Split Capacitor Motors:
1. Starting Torque: Exceeding 1/4 of full load torque.
2. Starting Current: Up to 6 times full load current.
3. Multiple Speed: Through tapped windings.

E. Single Phase Power – Capacitor Start Motors:
1. Starting Torque: Three times full load torque.
2. Starting Current: Less than 5 times full load current.
3. Pull-Up Torque: Up to 350% of full load torque.
4. Breakdown Torque: Approximately 250% of full load torque.
5. Motors: Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. 3-Phase Power – Squirrel Cage Motors:
1. Starting Torque: One to one and one-half times full load torque.
2. Starting Current: Six times full load current.
3. Power output, locked rotor torque, breakdown or pullout torque: NEMA Design B characteristics.
4. Design, construction, testing, and performance: Conform to ANSI/NEMA MG 1 for Design B motors.
5. Insulation System: NEMA Class B or better.
6. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Bearings:
   a. Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours.
   b. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension.
   c. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To ANSI/NEMA MG 1, 75 dBA SPL at 3 feet maximum.
9. Nominal Power Factor: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

2.5 RATINGS

A. Motors shall meet NEMA standards and be capable of operating at rated load with a voltage variation of ±10%, a variable of ±5% in rated frequency, or a combined variation of 10% without damage to the motor.

B. Motors shall be selected for the type of service involved and shall be selected at a minimum of 15% above the required rating of the equipment served. (Does not include service factor.)

2.6 BELT DRIVES

A. Belt drive motors shall be provided with adjustable sheaves with the selected equipment speed occurring at the midpoint of the adjustable range. Install belt guards over drives in accordance with OSHA requirements.

2.7 THERMAL OVERLOADS

A. Provide built-in thermal overloads on all fractional horsepower motors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All materials and equipment shall be installed in accordance with Manufacturer's recommended installation methods for obtaining conformance with the Contract Documents.

B. Alignment of all motors, factory coupled or mounted, and all motors field coupled and mounted, shall be rechecked after all connections have been made and after 48 hours of operation in designed service.

C. Verify the voltage characteristics of each motor prior to ordering.

D. Verify the correct wire connections and rotation of equipment by "bumping" motor after wiring.

E. Confirm voltage imbalance on 3-phase motors is less than 2%.

3.2 APPLICATION: Except as specifically indicated, motors shall be selected as follows:

A. Shaded pole motors are not acceptable.

B. Phase, except where noted otherwise:
   1. 1/2 HP and Less: Single-phase.
   2. Larger than 1/2 HP: Three-phase.

C. Single Phase Starting:
   1. 1/8 HP and Less: Split phase or permanent split capacitor.
   2. Greater than 1/8 HP: Capacitor start.

D. Enclosure:
   1. Totally enclosed fan-cooled (TEFC) for all motors located outside, in wet areas, in mechanical rooms, or elsewhere as indicated.
   2. Open drip-proof (ODP) for motors located elsewhere, in a clean, dry environment.

END OF SECTION 23 05 13

SECTION 23 05 19 – METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all temperature and pressure gages. Unless otherwise specified, gages shall be as described in this Specification.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASME Standard:
      a. B40.1 – Gages – Pressure, Indicating Dial Type – Elastic Element.
      b. B40.30 – 1990 – Thermometers.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all gages and thermometers. Include name of Manufacturer, model, dimensions, and scale range.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ametek.

B. Ashcroft.

C. H.O. Trerice.

D. 3D Instruments.

E. Trend Instruments.

F. Weiss.

2.2 EQUIPMENT

A. Dial Thermometer:
   1. Bimetal type with adjustable dial face.
   2. 5-inch diameter dial.
   3. 6-inch nominal stem length.
   4. Union lock nut.
   5. Zero adjustment.
   6. Hermetic seal.
   7. Equal to H.O. Trerice B85600 Series.

B. Industrial Thermometer:
   1. Aluminum case, acrylic face, adjustable angle, blue spirit filled tubing.
   2. 9-inch scale.
   3. 3-1/2-inch nominal stem length. (6-inch for pipe sizes 6 inches and over).
   4. Equal to H.O. Trerice BX91 Series.

C. Pressure Gage:
   1. Bourdon tube type or bourdon coil type with direct coupled pointer, liquid filled.
   2. 4-1/2-inch minimum diameter.
   3. Accuracy of +1% of scale range.
   4. Equal to H.O. Trerice 450 Series.
   5. Liquid fill must be compatible with temperatures in measured fluid.

2.3 ACCESSORIES

A. Thermowell:
   1. Provide for all thermometers.
   2. 304 stainless steel.
   3. Equal to H.O. Trerice Cat. No. 138-0015.3 (138.0016.2 for pipe 6 inches and over).

B. Coil Siphon:
   1. Provide for all steam system installations.
   2. Brass.
   3. Equal to H.O. Trerice Series 885.

C. Needle Valve:
   1. Provide for all pressure gages.
   2. Equal to H.O. Trerice Series 735.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all thermometers and pressure gages in conformance with:
   1. The Drawings.
   2. These Specifications.
   3. Manufacturer's recommendations.

B. Support all pressure gages and remote-reading thermometers:
   1. With 12-gage formed steel bracket.
   2. Secured to structure or equipment.

3.2 APPLICATION

A. Select all dial ranges such that normal operating temperature/pressure measured at point of installation is near mid-range.

END OF SECTION 23 05 19

SECTION 23 05 23 – GENERAL DUTY VALVES FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all valves.

1.3 REFERENCES

A. Except as specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.
   2. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
   3. Threaded: Valve ends complying with ANSI B2.1.
   4. Solder-Joint: Valve ends complying with ANSI B16.18.
   5. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
   6. Welded Ends: Valve ends complying with ASME/ANSI B16.5.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. General:
   1. This Section is provided as a guide in the application and specification of specific valves intended for use in this Project. This Section does not instruct where to install these valves unless specifically noted. Refer to other specific Mechanical Specification Sections and Drawing details for instruction for location and use.
   2. As indicated on the Drawings.
   3. As called out in the Piping Systems Schedules.

B. Valves not specifically indicated on the Drawings:
   1. Size and class of valve and pipe schedule to agree with line in which installed.
   2. All valves 2-1/2-inch and larger shall be flanged unless noted otherwise.
   3. All valves 8-inch and larger shall be furnished with suitable bypass valve and piping.

C. Valves shall have Manufacturer's name, trademark and working pressure rating cast into the valve body.

1.5 SUBMITTALS

A. Shop Drawings for all valves.

B. Manufacturer's Literature: For All Valves:
   1. Manufacturer's name.
   2. Details of construction.
   3. Performance characteristics.
   4. Pressure and temperature ratings.
   5. Close-off pressure.

1.6 QUALITY ASSURANCE

A. Made in USA:
   1. Unless specifically noted otherwise, all valves shall comply with the Federal Trade Commission Made in USA standard.
   2. Supplier shall furnish documentation of USA content if requested by Engineer.

B. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the material and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Valves shall be manufactured by one Manufacturer for each type of valve. Where valve Manufacturers are not specifically indicated, they shall be one of the following:
   1. Gate, Ball, Globe, Standard Butterfly, and Check Valves:
      a. Nibco.
      b. Kennedy.
      c. Crane.
      d. Milwaukee.
      e. Keystone.
      f. Stockham.
      g. Bonney Forge.
      h. Mueller Steam Specialties.
      i. Neles-Jamesbury.
      j. DeZurik.
      k. Apollo.
      l. Vogt.
      m. Walworth.
      n. Powell.
   2. Triple Offset Butterfly Valves (2TBF2W):
      a. Adams (300 ANSI carbon steel type MAK).
      b. Zwick Tri-Con Series S
      c. Vanessa 30,000 Series.
   3. High Performance Butterfly Valves (2HBF2F):
      a. EBRO Armaturen.
      b. Metso/Jamesbury.
      c. Dezurick.
   4. Spring-Loaded Check Valves (2CK1W):
      a. Advance Valve Co., “Durabla SCV.”
      b. CheckAll Valve Manufacturing Co.
   5. Control Valves – Globe Valves (Hydronic Service):
      a. Honeywell.
      b. Johnson.
      c. Siemens.
   6. Control Valves – Characterized Ball Valves (Hydronic Service Only):
      a. Honeywell.
      b. Johnson.
      c. Siemens.
      d. Apollo.
      e. Belimo.

2.2 GENERAL

A. Materials – Bronze Valves:
   1. All brass alloys used in valves shall contain no more than 15% zinc.
   2. Alloys must comply with ASTM B61, B62 or B584.

B. Additional Materials: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by the Manufacturer for installation requirements.
   1. Provide extended stem handles and necks with a minimum clearance of 1-1/2-inch on insulated service.
   2. All valves used for throttling/balancing shall have adjustable memory stops.
   3. Pressure ratings are at service indicated by application as specified according to the individual valve specifications.
   4. Sizes: Same size as upstream pipe, unless otherwise indicated.
   5. Neck extensions and right angle drives where indicated and where required for access to the operator.

C. Operators: Provide the following special operator features:
   1. Handwheels, fastened to valve stem, for valves other than quarter turn.
   2. Lever handles, on quarter-turn valves 3-inch and smaller, except for plug valves. Provide plug valves with square heads. For valves greater than 3-inch, provide gear operator with handwheel.
   3. Provide bevel gear operators with chain-wheels for all valves installed 6 feet or higher above finished floor. Extend chains to an elevation of 5 feet above finished floor.
   4. Provide rotary manual actuators with high ratio (80 to 1 minimum), disc positions and open and closed position stops on all butterfly valves. Actuators shall be designed for valve installation with the stem in a horizontal orientation to prevent debris from accumulating in the bearings.
   5. Automatic Operators: Provide in accordance with Division 23 Section “Instrumentation and Control for HVAC.”

D. Bypass and Drain Connections: Provide valved bypass where indicated on the Drawings. Comply with MSS SP-45 bypass and drain connections.

E. Valve Identification Systems Description:
   1. A system has been established which identifies the specific valves for each piping system as indicated on the Drawings. The specific valve specification is linked by the service number as depicted in the "Valve Index" listed in this Section.
   2. Valves may be identified on the Drawings by symbol. Size is indicated by the upstream size.
   3. Valves are specified in this Section according to the "Valve Index". In general, the following is a description of the format:
      a. The first symbol, consisting of one or more numerals, indicates the valve group pressure and temperature specification that applies to this valve.
      b. The second symbol, consisting of one or more letters, indicates the type of valve in accordance with the following listing:
         1) GB = Globe Valve.
         2) TBF = Triple Offset Butterfly Valve.
         3) HBF = High Performance Butterfly Valve.
         4) BF = Standard Butterfly Valve.
         5) BL = Ball Valve.
         6) CK = Check Valve.
         7) SCK = Silent Check Valve.
         8) GT = Gate Valve.
      c. The third symbol consists a numeral which indicates the size group.
      d. The fourth symbol, consisting of a letter, indicates the type of connection to the valve as follows:
         1) F = Flanged Ends.
         2) S = Screwed Ends.
         3) W = Weld Ends, Butt, or Socket.
      e. For example: For a 10-inch CHW shutoff valve, refer to 1BF2F which indicates a valve of Valve Group 1, Butterfly Type, and with flanged ends.
   4. There may be some instances where it is desirable to substitute an item, such as a valve or gasket at a particular location, in place of the one specified in the groups listed in the Index. In that event, the item will be clearly indicated and specified on the Drawings, and such an indication is to take precedence over the item specified in the valve group specifications. All other terms of that group specification are to be observed.

2.3 VALVE GROUP 1

A. Gate Valves:
   1. Symbol: 1GT1S – 2 Inches and Smaller:
      a. Class 125 valves used for piping 2 inch in size and smaller shall all bronze, bolted bonnet, rising stem, solid wedge, bronze mounted, screwed ends, and designed for 125 psig.
   2. Symbol: 1GT2F – 2-1/2 Inches and Larger:
      a. Class 150 steel gate valve, flanged ends, bolted flanged bonnet, outside screw and yoke, rising stem, flexible or solid wedge disc, renewable seat rings and disc.
      b. Materials shall be: Body and bonnet, ASTM A216, Grade WCB or A105; carbon steel body; stem, disc face and seat rings 13% chromium stainless steel or a combination of 13% chromium stainless steel and nickel-copper, stellite or a combination of stellite and 13% chromium stainless steel as recommended by its manufacturer for steam service.
      c. Face to face dimension shall conform to ANSI B16.10. Flanges shall be faced and drilled to ANSI B16.5.
      d. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).
      e. Where indicated on the Drawings, provide an enclosed gear operator.

B. Globe Valves:
   1. Symbol: 1GB1S – 2-inch and smaller :
      a. 125 pounds wsp, bronze body, rising stem, screwed bonnet, Teflon disc, and renewable seat.
      b. Solder joint end 2-inch and smaller:300 CWP, bronze body, rising stem, screwed bonnet, Teflon disc, and renewable seat.
   2. Symbol: 1GB2F – 2-1/2 inch and larger:
      a. Flanged end, Class 125, iron body.
      b. Bronze trim, OS&Y bonnet, teflon disc, renewable seat, and spring-loaded packing.

C. Ball Valves:
   1. Symbol: 1BL1S – 2 Inches and Smaller:
      a. Ball valves used in connection with piping 2 inches in size and smaller shall have screwed or sweat ends, 2 piece bronze body, standard port with stainless steel ball and a like stem. VA rated for 150 pound SWP and 600 WOG. Seats and seals shall be reinforced virgin teflon for standard duty cycle.
   2. Symbol: 1BL2F – 2-1/2 Inches and Larger:
      a. Ball valves used in connection with piping 2-1/2 inches in size and larger shall have flanged ends, 2 piece bronze body, standard port with stainless steel ball and a like stem. VA rated for 150 pound SWP and 600 WOG. Seats and seals shall be reinforced virgin teflon for standard duty cycle.

D. Standard Duty Butterfly Valves:
   1. Symbol: 1BF2F – 2-1/2 Inches and Larger:
      a. Iron body rated for 175 psig and 250 degrees F, bubble-tight shutoff.
      b. Lug body for use with ANSI flanges. Wafer style is not acceptable, except where specifically approved.
      c. Stainless steel disc, 416 stainless steel shaft, EPDM seat.
      d. Provide neck extended 2 inches beyond flange diameter.
      e. Bevel gear operator.

E. Plug Valves:
   1. Plug valves shall be nonlubricated eccentric plug type rated for 175 CWP with semi-steel body neoprene coated plug and epoxy coated seat; equal to DeZurik PEC or Homestead Series 300. Furnish with compatible wrench. All valves used for throttling/balancing to have adjustable memory stop.
   2. Plug valves (gas cock) for natural gas shutoff applications shall be lubricated type equal to Homestead Figure 611 or 612 or Rockwell Figure 114 or 115.

F. Check Valves:
   1. Symbol: 1CK1S – 2 Inches and Smaller:
      a. Class 150 horizontal swing check valve, cast bronze body and cover, screwed ends, bronze seat and disc, screwed cover, integral seat, body and cover material to conform to ASTM B61 or B62.
      b. Provide valves capable of being reground while the valve remains in the line.
      c. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.
      d. The valve shall conform to MSS SP-80.
   2. Symbol: 1CK2F – 2-1/2 Inches and Larger:
      a. MSS SP-71; Class 125 cast iron body and bolted cap conforming to ASTM A126, Class B.
      b. Horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends.
      c. Face to face dimension shall conform to ANSI B16.10. Flange shall be faced and drilled to ANSI B16.5.
      d. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).

G. Silent Check Valve:
   1. Symbol: 1SCK1S – 2 Inches and Smaller:
      a. Install silent check valves in all pump discharge.
      b. Piping less than 2-inch: 300 pounds, bronze body, renewable bronze disc screwed or sweat ends, bronze trim.
      c. Mueller Steam Specialties, #303 BP; or equal.
   2. Symbol: 1SCK2F – 2-1/2 Inches and Larger:
      a. 125 pounds, globe type, iron body, bronze trim, renewable seat and disc, SS springs.
      b. Mueller #105-AP; or equal.

PART 3 - EXECUTION

3.1 VALVE SCHEDULE

A. Unless otherwise noted on drawings or in specific application sections of this specification, the valve groups described in Part 2 of this specification shall be applied for each service type as follows:
   1. Valve Group 1:
      a. Hydronic (heating water) supply and return not exceeding 125 psig or 250 degrees F.

3.2 INSTALLATION

A. Install valves in conformance with:
   1. The Shop Drawings reviewed by Engineer.
   2. The Manufacturer's recommendations.

B. Install Valves:
   1. At all branch piping connection to mains.
   2. At all connections to equipment.
   3. As required for complete control or isolation of any piece of equipment or service to branch lines.
   4. In accessible locations.
   5. Equal in flow area to connecting piping, unless otherwise indicated.

C. No valve shall be installed with its stem below the horizontal.

D. Furnish chain operated hand wheels, including rust-proof chain and chain guide for inaccessible overhead valves.

E. Install flanged valves at equipment in a manner which allows equipment side of valve to be opened up without draining piping system.

END OF SECTION 23 05 23

SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all pipe hanging and support systems.

B. Refer to Division 23 Section “Metal Ducts” for duct hanging requirements.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASME – American Society of Mechanical Engineers:
      a. B31.1 – Power Piping.
      b. B31.9 – Building Services Piping.
      c. B31.8 – Gas Transmission and Distribution Piping Systems.
   2. MSS – Manufacturers Standardization Society:
      a. SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture.
      b. SP-69 – Pipe Hangers and Supports – Selection and Application – 1996.
      c. SP-90 – Guidelines on Terminology for Pipe Hangers and Supports.

1.4 DEFINITIONS

A. Pipe Restraint: Pipe supporting element which is designed to limit or direct pipe movement due to internal static pressure, gravitational forces, frictional forces from hangers, rollers, and guides, and forces from expansion compensation devices:
   1. Pipe restraints are not designed to restrain pipe movement caused by thermal expansion, shock or surge.

B. Pipe Guide: A pipe restraint designed to direct pipe movement along a single axis.

C. Pipe Anchor: A pipe restraint designed to provide a static point about which pipe movement normally occurs, by limiting the longitudinal and axial movement at that point.

D. Other Terms: As defined in MSS SP-90.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated on Drawings or in these Specifications, this Contractor shall be responsible to design and provide all pipe hangers, supports, restraints, braces, framing, etc., as required to comply with all applicable building codes, ASME B31 and MSS SP-69.

B. Comply with the requirements of Division 23 Section “Sound and Vibration Control for HVAC” for vibration isolation of piping.

C. Comply with the requirements of ASME B31.8 for pipe hangers and support of natural gas piping systems.

1.6 SUBMITTALS

A. Manufacturer's Literature: For structural steel attachment devices, hangers and rollers. Include name of Manufacturer; model number and MSS Type, if applicable; and piping systems to be used with.

B. Submit Shop Drawings for all engineered hanger, restraints and support assemblies.
   1. For Metal Framing Pipe Supports: Include locations, dimensions, lengths, Manufacturer, material, cross-section number or type, finish, pipe sizes, and pipe locations.

C. Upon request by Engineer, submit calculations for all engineered hanger, restraints and support assemblies.
   1. Calculations: For metal framing pipe supports upon request by Engineer. Include support locations, pipe sizes, pipe weights, allowable stresses, and actual stresses.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The materials of all pipe hanging and supporting elements shall be in accordance with the latest requirements of the ASME Code for Pressure Piping B31.1 and MSS Standard Practice MSS SP-58 and MSS SP-69 except as supplemented or modified by the requirements of these Specifications.

B. The material in contact with the pipe shall be compatible with the piping material so that neither shall have a deteriorating action on the other.

C. Special Finishes and Materials:
   1. All ferrous hangers and supports used in the following areas shall be hot dip galvanized unless noted otherwise:
      a. Outside.
      b. In wet or potentially wet areas.
   2. 316 stainless steel hangers and supports shall be used where exposed in the following areas:
      a. Kitchens and other food preparation areas.

2.2 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Elcon.
   2. Michigan Hanger.
   3. Anvil.
   4. Bergen.
   5. Hilti.
   6. Lindapter.
   7. Thybar.
   8. Pate.
   9. Miro.
   10. Roof Products and Systems.
   11. A.E.S.
   12. MicroMetl.
   13. PHD Manufacturing.

2.3 PIPE HANGERS AND SUPPORTS

A. Horizontal Piping Hangers: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).
   2. Yoke Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F (49 to 232 degrees C) pipes, NPS 4 to NPS 16 (DN100 to DN400), requiring up to 4 inches (100 mm) of insulation.

3. Carbon or Alloy Steel, Double Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN20 to DN600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN15 to DN600), if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN15 to DN100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable Swivel Split or Solid Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8 (DN20 to DN200).
7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
9. Adjustable Swivel Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).
10. Split Pipe Ring With or Without Turnbuckle Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN10 to DN200).
11. Extension Hinged or 2 Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN10 to DN80).
12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30 (DN15 to DN750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

B. Supports and Rollers:
1. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast iron floor flange.
2. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast iron floor flange with U-bolt to retain pipe.
3. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion type support for pipes, NPS 2-1/2 to NPS 36 (DN65 to DN900), if vertical adjustment is required, with steel pipe base stanchion support and cast iron floor flange.
4. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN25 to DN750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
5. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN65 to DN500), from single rod if horizontal movement caused by expansion and contraction might occur.
6. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN50 to DN1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
7. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN50 to DN600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
8. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN50 to DN750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

C. Vertical Piping Clamps: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).
2. Carbon or Alloy Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500), if longer ends are required for riser clamps.

D. Hanger Rod Attachments: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 degree F (49 to 232 degree C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type II, split pipe rings.
4. Malleable Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 degree F (49 to 232 degree C) piping installations.

E. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
   1. Restraint Control Devices (MSS Type 47): Where indicated to control piping movement.
   2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
   3. Spring Cushion Roll Hangers (MSS Type 49): For equipping Type 42 roll hanger with springs.
   4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
   5. Variable Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from hanger.
   6. Variable Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from base support.
   7. Variable Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from trapeze support.
   8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load adjustment capability. These supports include the following types:
      a. Horizontal (MSS Type 54): Mounted horizontally.
      b. Vertical (MSS Type 55): Mounted vertically.
      c. Trapeze (MSS Type 56): Two vertical type supports and 1 trapeze member.

2.4 HANGER RODS

A. Minimum rod diameters for rigid rod hangers shall be as shown in MSS SP-69 Table 4 (Minimum Rod Diameter for Single Rigid Rod Hangers) and as indicated in Part 3 of these Specifications.

B. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing.

C. Rod material must be compatible with hanger and comply with above. Do not field cut thread on galvanized rod.

D. Do not use perforated strap.

E. Multiple Supports:
   1. Horizontal banks of pipe may be supported on a common base member without regard to the pipe centerline elevation.
   2. In the supporting of multiple pipe runs, provisions shall be made to keep the lines in their relative lateral positions, using clamps or clips as required. Lines subject to thermal expansion shall be free to roll axially or slide.

2.5 SADDLES AND SHIELDS

A. All Piping:
   1. Saddle: MSS Type 39 Anvil Figure 160 -to 165.
   2. Shield: MSS Type 40 (Anvil Figure 167), provide and install in accordance with Manufacturer's shield size selection tables.
   3. The contour of the saddle shall match the radius of the pipe insulation.

2.6 ALIGNMENT GUIDES

A. Provide at all expansion loops and joints:
   1. As indicated on the Drawings.
   2. As required to maintain alignment.
   3. In accordance with Expansion Joint Manufacturer's Association recommendations.

B. Pipe Slides and Guides:
   1. Manufacturer:
      a. Advanced Thermal Systems, Inc.
      b. As approved by Owner.
   2. Model:
      a. Figure 101-W for guide weld down applications.
      b. Figure 101-B for guide bolt down applications.
      c. Figure 201-W for slide weld down applications.
      d. Figure 201-B for slide bolt down applications.
   3. Size: Appropriate for pipe size, insulation thickness and length of travel.
   4. Minimum Length of Travel:
      a. For the first 1/4 of the distance from the anchor to the expansion joint -25% of design travel length of joint.
      b. For the second 1/4 of the distance from the anchor to the expansion joint -50% of design travel length of joint.
      c. For the third 1/4 of the distance from the anchor to the expansion joint -75% of design travel length of joint.
      d. For the last 1/4 of the distance from the anchor to the expansion joint – design travel length of joint +25%.

C. Spider Type Guides:
   1. Manufacturers:
      a. Anvil.
      b. Pentair – ERICO.
      c. Keflex.
   2. Anvil Figure 255, 256; or equal.

2.7 FABRICATED STEEL SUPPORTS AND RESTRAINTS

A. Provide as required:
   1. Steel shapes and plates.
   2. Bolts.
   3. Welds.

B. Materials and fabrication in accordance with:
   1. AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
   2. AISC Code of Standard Practice for Steel Buildings and Bridges (except Section 4.2.1.).

C. Design: Responsibility of Subcontractor.

D. Paint all finished fabrications:
   1. As specified in Division 09.
   2. Color as directed by Owner.

2.8 BUILDING ATTACHMENTS

A. As indicated on the Drawings or in the Specifications.

B. Concrete Attachments:
   1. Provide galvanized finish for all attachments used in wet or potentially wet areas.
   2. Provide stainless steel bolts and nuts in wet and potentially wet areas.
   3. Poured Concrete:
      a. Use cast-in-place inserts or bolted surface mounted attachments, at Contractor’s option.
      b. Expansion style anchors are not permitted on piping systems subject to vibration.
   4. Precast Concrete Tees:
      a. Use fittings specifically designed for attachment to stems of precast tees.
      b. Drilling is not permitted except where specifically approved by Engineer and coordinated with precast Manufacturer to miss embedded, prestressed steel strands.

5. Precast Concrete Plank:
   a. Use toggle bolt attachment as indicated on Drawings.
   b. Alternatively, provide adhesive anchor, Hilti HY-20; or as approved.
   c. Drilling is not permitted except where specifically approved by Engineer and coordinated with precast Manufacturer to miss embedded, prestressed steel strands.

C. Horizontal Piping:
   1. Steel W, I, or S shapes: MSS Type 23 clamp with retaining clip, (Anvil Fig. 88 and Fig. 89 for non-seismic and Fig. 89X for seismic applications) up to 2-inch; MSS Type 28 (Anvil Fig. 292) or MSS Type 21 (Anvil Fig. 133, 134) above 2-inch.
   2. Steel Channel: MSS Type 20 universal channel clamp.
   3. Bar Joists: Steel washer plate (Anvil Fig. 60).
   4. Concrete: See "B" above.
   5. Timber: Angle bracket and lag screws or as detailed on Drawings.
   6. Steel Z Shapes: Custom attachment required.

D. Vertical Piping:
   1. Steel Shapes: Welded brackets as approved by Engineer.
   2. Concrete: See "B" above.
   3. Timber: Ceiling hanger flange (Anvil Fig. 128R, 153) angle brackets and lag screws, or as indicated on Drawings.

E. In the absence of a Specification for a particular type of attachment, furnish attachments comparable in type and quality to that specified above for a similar situation.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. General Requirements:
   1. The selection of hangers and supports shall be based on the overall design concept of the system and any special requirements which may be called for in these Specifications or as indicated on the Drawings. The support systems shall provide for, and control, the free or intended movement of the system including its movement in relation to that of the connected equipment. They shall prevent excess stress resulting from the transfer of weight being introduced into the system or connected equipment.
   2. The selection of hangers and supports shall be made to provide the system with the degree of control that its operating characteristics require. Design hangers and supports to prevent sway and intendent movement.
   3. The selection of hangers or supports will take into consideration the combined weight of the supported systems, including system contents.
   4. Select and install hangers and supports to allow controlled thermal and seismic movement of system, to permit freedom of movement between anchors, and facilitate action of expansion joints, expansion loops, expansion bends and similar units.
   5. The spans in MSS SP-69 Table 3 do not apply where concentrated weights, such as valves or heavy fittings, or where changes in direction of the piping occur between hangers.
   6. Select all hangers and supports rated for the maximum potential loading with pipe full.
   7. Select hangers for cold (less than 50 degrees F) piping service for installation over the insulation.
   8. Where significant, vertical movement of pipe occurs at the hanger location a resilient support shall be used:
      a. Selection of resilient supports shall be based on permissible load variations and effects on adjacent equipment. Support selection for typical load variations are shown on MSS SP-69 Table 2 (Spring Support Selection). Load and movement calculations shall be made for the proper selection of spring hangers.
      b. Vertical movement and load transfer from riser expansion to horizontal runs shall be given consideration when applying spring hangers.
      c. Spring cushion hangers may be used where vertical movement does not exceed 1/4-inch and where formal load and movement calculations are not required.

d. Variable spring hangers shall be used for all other resilient support requirements except as noted in the following paragraph.
e. Constant support hangers shall be used on piping systems where the deviation in supporting force must be limited to 6% and which cannot be accommodated by a variable spring hanger.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. General:
1. Adjust all components as required for proper operation and required pipe slope.
2. Double nut all support rods at hangers.
3. Location and Routing:
a. Install Piping as Indicated:
1) On the Drawings.
2) On the reviewed Shop Drawings.
b. Secure Engineer's approval for all pipe routing changes.
4. Coordinate with other trades for placement of concrete attachments prior to concrete pouring.
5. Install all items in accordance with Manufacturer's instructions.

C. Support at Valves: Provide additional supports at all valves in piping 4-inch and larger.

D. Vertical Risers:
1. Support independently from adjacent hangers on horizontal piping.
2. Copper Piping:
a. Support at the base and at 6-foot maximum centers for sizes 1-1/4-inch and smaller.
b. Pipes Larger Than 1-1/4-Inch:
1) Supported at each floor level.
2) Not to exceed 10-foot centers.
3. Vertical Threaded, Welded or Grooved Steel Piping:
a. Support at the base of the riser and at every other floor.
b. Maximum allowable unsupported piping length is 12 feet.
4. Plastic Piping:
a. Support at 4-foot centers maximum for sizes 1-1/2-inch or smaller.
b. Support at the base and at 4-foot centers for all sizes larger than 1-1/2 inches.
c. Completely encircle covering and insulating material.

E. Horizontal Runs:
1. General:
a. Provide adequate supports for the loads with a factor of safety of at least 5 (400 pounds minimum).
b. Provide protective shield at all hangers and rollers supporting plastic pipe and coated pipe.
c. Support spacing not to exceed MSS SP-69 Table 3, or the requirements for seismic restraint, whichever is more stringent.
d. Hanger rod diameter shall not be less than the requirements of MSS SP-69 Table 4, or the requirements for seismic restraint, whichever is more stringent.
2. Rollers: All piping systems designed to accommodate thermal expansion movement shall be mounted on rollers.
3. Bar Joists: Attachments to bar joists shall be made to top member and at panel points.

F. Ductile Iron Piping: The size of hanger components shall be suitable for the O.D. of the pipe to be supported.

G. Fiberglass Reinforced Pipe (FRP):
   1. The size of hanger components shall be suitable for the O.D. of the pipe to be supported.
   2. Support spacing shall be based on the Manufacturer's recommendation for the service conditions.
   3. FRP should not be point loaded and all shields and hangers in contact with the pipe shall be free of burrs.

3.3 PIPE RESTRAINTS

A. Provide adequate pipe restraints for all expansion or contraction of piping due to temperature change:
   1. Including, but not limited to, that indicated on the Drawings.
   2. As instructed by Owner or Engineer.
   3. At locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent transfer of loading and stresses to connected equipment.
   4. Spacing: Unless otherwise indicated, install at ends of main pipe runs, at intermediate joints in pipe runs between expansion loops and bends.

B. Concrete work installed in connection with anchors or supports: Make with approved Portland Cement:
   1. At least 5-1/2 bags per cubic yard.
   2. Properly mixed with approved aggregate.
   3. Attain a compression strength of not less than 3,000 psi at 28 days.

3.4 VIBRATION ELIMINATORS

A. Provide as indicated on the Drawings and in accordance with the requirements of Division 23 Section "Sound and Vibration Control for HVAC."

B. Install so as to cause minimum restraint to normal thermal movements.

3.5 INSULATION PROTECTION

A. Provide Protection Saddle:
   1. Equal to insulation thickness.
   2. At each hanger.
   3. For all insulated piping systems where longitudinal expansion exceeds 1-inch per 100 feet.

B. Provide calcium silicate treated with water repellant inserts for all insulated systems larger than 3-inch IPS. Anvil Fig. 160 to 165 is also acceptable. Refer to Division 23 Section "HVAC Piping Insulation."

C. Provide insulation protection shield:
   1. At each hanger for all "cold" (less than 50 degrees F) piping services.
   2. In accordance with the following table:

Pipe Size (IPS)	Shield Gage	Length
5" and Smaller	16	12"

   3. Installed as follows:
      a. Surround lower covering.
      b. Straddle equidistant on hanger.
      c. Flared at both ends as required to avoid damage to pipe covering, jacket and vapor barrier.

3.6 PAINTING

A. Touchup: Cleaning and touchup of painting of field welds, bolted connections and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

B. Galvanized Surfaces: Clean welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION 23 05 29

SECTION 23 05 31 – PENETRATIONS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Duct and pipe sleeves.
   2. Prefabricated and site built curb assemblies.
   3. Flashing and sealing of all mechanical openings through weather or waterproofed walls, roofs and floors.
   4. Sealing and finishing of all mechanical openings.
   5. Provide UL rated firestopping and sealing at all new and existing pipe penetrations of fire rated walls.

B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. General Contractor:
      a. Locate and place all sleeved and framed openings as part of constructing the wall and floor surfaces in which the openings occur.
      b. Provide all lintels and required stiffening members for wall and floor openings.
      c. Cut roofing and install flashing for all required openings in proprietary roof membrane systems.
      d. Cut all roof deck openings and provide required framing supports.
   2. Mechanical Subcontractor:
      a. Advise General Contractor of quantity, location and size of all required openings.
      b. Provide all curbs, sleeves, seals, escutcheons and related materials required for finishing, sealing and waterproofing mechanical openings. Furnish all flashing and counterflashing.
      c. Arrange and pay for all openings that are found to be required after wall, roof and floor construction has been completed.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with ASTM D2202 – Test Method for Slump of Sealants.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all premanufactured curbs and sealing assemblies.
   1. Manufacturer's name.
   2. Model number.
   3. Details of construction and installation.
   4. Certified load-bearing data for all curbs.

B. Delegated-Design Submittal:
   1. Structural calculations for anchorage systems, sealed by the Professional Engineer responsible for the design.
   2. Clearly indicating design criteria and loadings used.
   3. For each vibration isolation and seismic-restraint device.
      a. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation

1.5 PERFORMANCE REQUIREMENTS

A. Design Responsibilities:
   1. Anchorage of outdoor equipment shall be designed by Contractor.
   2. Minimum Requirements:
      a. Details, if any, indicated on the Drawings and Specifications contained herein are minimum requirements.
         1) Engineer has designed the structure to withstand the gravity and wind induced loadings of equipment.
         2) Notify Engineer of member size change requirements prior to fabrication.
      b. Generally comply with layouts and configurations as indicated on the Drawings.
   3. Structural Performance:
      a. Design shall be performed by a professional engineer.
      b. Design shall comply with the building code plus amendments and local ordinances, if any, legally adopted for the location in which the Project is located.
      c. Design anchorage systems capable of withstanding design loads within limits and under conditions indicated.
         1) The term "withstand" means that the unit will remain in place without separation of any parts from the device when subjected to the wind forces specified.
      d. Design shall include systems that transfer gravity and wind induced loadings (including lateral, overturning and uplift effects) to the structure, including, but not limited to:
         1) Anchorage between units and curbs.
         2) Anchorage between curbs and building structure.
         3) Spacers, blocking, straps and the like.
   4. Design Loads:
      a. Dead Loads: Actual weights of materials and fixed equipment, as calculated by designer.
      b. Wind-Restraint Loading:
         1) Determined by designer in accordance with the basic parameters indicated on the Drawings and procedures indicated in the Building Code.
         2) Design shall not consider shielding by adjacent structures.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Codes and Standards: "Architectural Sheet Metal Manual" as published by SMACNA.

C. Delegated Designer Qualifications:
   1. Professional Engineer licensed in the state in which the Project is located.
   2. Having experience in a minimum of 5 projects in the last 10 years of comparable or greater complexity

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Curbs:
   1. The Pate Company.
   2. Roof Products and Systems Corporation.
   3. Thycurb Corporation.
   4. A.E.S.
   5. MicroMetl.

B. Pipe Seals and Boots:
   1. The Pate Company.
   2. Portals Plus, Inc.
   3. Roof Products and Systems Corporation.
   4. Thunderline Corporation.
   5. Thycurb Corporation.

C. Modular Mechanical Seals:
   1. Thunderline/Link-Seal.
   2. As approved.

D. Backer Rod: Industrial Thermo Polymers, “Standard Backer Rod”.

E. Acoustical Sealant: Pecora, “BA-98”.

F. Expanding Resilient Foam: General Electric, “RTF762.”

2.2 MATERIALS

A. Backer Rod:
   1. Extruded round, closed cell, polyethylene foam.
   2. Resilient, non-exuding.
   3. Density: 2.0 pounds per cubic foot.
   4. Tensile Strength: 50 psi.
   5. Nonabsorbent to water and gasoline.
   6. Suitable for use as a backing for acoustical sealant.
   7. Compatible with sealant and approved by sealant Manufacturer.

B. Acoustical Sealant: Nonfire-Rated Penetrations:
   1. Non-drying, non-hardening and non-bleeding.
   2. Laboratory tested sealant which effectively reduces airborne sound transmission through wall systems.
   3. Viscosity: 350,000 to 400,000 (Brookfield No. 65, 10 RPM).
   4. Aging: Firm but rubbery, good tack after 50 days conditioned at 160 degrees F.
   5. Slump: 0.1 to 0.2 inches in accordance with ASTM D2202.
   6. Color: Gray.

C. Packing Material for Penetrations:
   1. Glass Fiber or Mineral Fiber:
      a. Noncombustible.
      b. Resistant to water, mildew, and vermin.
   2. Expanding Resilient Foams:
      a. Acceptable alternative if manufactured for this purpose.
      b. Minimum material density: 60 pounds per cubic foot.

2.3 SLEEVES

A. Materials:
   1. 18-Gage Galvanized Steel:
      a. For ductwork openings.
      b. For pipe penetrations in non-bearings walls.
   2. Schedule 40 Steel Pipe:
      a. For all bearing walls.
      b. For all floors.
      c. For all concrete or masonry walls.
   3. Cast Iron Pipe: For all exterior below grade installations.

B. Size All Sleeves:
   1. To allow for movement due to expansion, without contact to pipe or insulation.
   2. As indicated on the Drawings.

2.4 MANUFACTURED UNITS

A. Box Section Design Curbs:
   1. Fabrication:
      a. Galvanized steel construction.
      b. Continuous mitered and welded corner seams.
      c. Base plate compatible with roof system.
      d. Straight-sided. No curb with cant shall be allowed.
      e. Preservative treated wood nailer.
      f. 1-1/2-inch rigid glass fiber insulation with anti-microbial material to resist the growth of fungi and mold.
   2. Select curb height so that Mechanical equipment air inlet/outlet is at least 12 inches above finished roof surface with base set on roof deck.
   3. Provide shims or special base as required for level assembly.
   4. Provide continuous mounting flange with neoprene equipment mounting gasket.
   5. Curbs for fans and similar mechanical equipment items are furnished by equipment Supplier unless specified otherwise.

B. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.

C. Exterior Wall or Roof Pipe Opening Seals:
   1. Compatible with installation conditions.
   2. Equal to One of the Following:
      a. Pate "Pipe Seal".
      b. Pate “Pipe Curb Assembly”.
   3. Link-Seal.

D. Modular Mechanical Seals:
   1. Provide modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
   2. The elastomeric element shall be sized and selected in accordance with Manufacturer's recommendations and have the following properties as designated by ASTM:
      a. For Standard Service Applications:
         1) -40 to +250 degrees F (-40 to +121 degrees C).
         2) EPDM = ASTM D2000 M3 BA510.
      b. For High Temperature or Fire Seal Applications:
         1) -67 to +400 degrees F (-55 to +204 degrees C).
         2) Silicone = ASTM D2000 M1GE505.

PART 3 - EXECUTION

3.1 ROOF OPENINGS

A. Ducts:
   1. Pass through prefabricated curbs.
   2. Curb Counterflashing:
      a. Provide formed galvanized sheet metal in accordance with Division 07 Section “Sheet Metal Flashing and Trim.”
      b. Solder or pop-rivet with mastic to the duct and extended over and down the top of the curbs for a minimum distance of 2 inches.
      c. Secure to the sides of the wood strips with corrosion-protected lag screws and washers 12 inches on center.

B. Piping:
   1. As indicated on the Drawings.
   2. For Multiple Pipes Through Single Opening:
      a. Select sleeve or opening seals of ample size to accommodate pipes.
   3. Fill Annulus Opening:
      a. Use non-combustible insulation material.
      b. Full depth of sleeve.
   4. Provide Moisture Protection Using Premanufactured:
      a. Elastomeric boot.
      b. Metal hood.
      c. Flashing fitting.

C. Locate curbs and sleeves a minimum of 12 inches from walls to permit proper flashing.

3.2 INTERIOR WALL AND FLOOR OPENINGS

A. Flash all floor-mounted drains except in slabs on grade:
   1. Use integral flashing flange and clamp.
   2. As specified in Division 22 Section “Plumbing Piping and Specialties.”

B. Use riser sleeve with integral flashing flange and clamp for all waterproof membrane floors.

C. Seal airtight all openings around pipes and ducts in the structure at Noise-Critical rooms:
   1. Lake House Rooms: 103, 107, 108, 109, 111, 112, 113, 115, 117, 118.
   2. Lake Hall Rooms: 158, 159, 161, 163, 164, 165, 166, 167, and Unoccupied Attic.
   3. Penetrations of all drywall ceilings and concrete slabs suspended on isolators.
   4. All enclosed shaft penetrations.

D. Duct Penetrations:
   1. Where each duct passes through a wall, floor, or ceiling, there shall be a clear annular space of 1-inch (25 mm) between the duct and structure.
   2. Frame, sleeve, or grout all voids in opening perimeter to contain packing material.
   3. After all of the ductwork is installed, check the clearance, and pack the voids full depth with packing material. In walls and floors of noise-critical spaces (see above), calk both ends with acoustical sealant backed by a backer rod or permanently flexible firestop material.
   4. Where there is not sufficient access space to pack around all sides of a duct (for example, at the underside of a slab), first place a short stub duct in the wall, pack and calk around it, and then attach the inlet and outlet ducts to each end.
   5. Where ducts enter or leave a shaft or pass through a wall or slab in sufficient numbers and density that individual pack-and-calk details are not possible, special isolation details shall be developed:
      a. Before the shaft is fully enclosed, seal the penetration with a heavy membrane surrounding the ducts on each side of the wall or slab being penetrated.
      b. Each membrane may be 2 layers drywall, 1-inch (25 mm) plaster or 14-gage lead sheet.
      c. Other materials may be acceptable.
      d. Pack the void between the 2 membranes with packing material or pump full of resilient closed cell firestop foam.
      e. Calk all edges airtight.
      f. In all cases, the proposed detail shall be approved by Engineer.

E. Pipe Penetrations:
   1. HVAC Piping:
      a. Where a pipe passes through a wall, ceiling, or floor, place cast or grout a sleeve into the structure.
      b. Internal diameter of the sleeve: 2 inches (50 mm) larger than the external diameter of the bare pipe or pipe insulation O.D. passing through it.
      c. After all of the piping is installed in a specific area, check the clearance and correct it, if necessary, to within 1/2-inch (12 mm).
      d. Pack the void full depth with packing material and seal at both ends, with minimum 1-inch (25 mm) deep sealant.

e. In walls and floors of noise critical spaces (see above), pack with acoustical sealant backed by foam rod.
f. Where pipes pass through a masonry wall in sufficient numbers and density that individual pack-and-calk details are not possible, a special isolation detail shall be developed:
   1) Cast pipe sleeves in a block of concrete with the sleeves located a minimum of 2 inches (50 mm) apart.
   2) Block thickness: At least as thick as the surrounding wall construction.
   3) Each sleeve diameter: 2 inches (50 mm) larger than the external diameter of the pipe passing through it.
   4) Build the sleeved block into the wall.
   5) After the pipes are installed, pack and calk voids as indicated above.

3.3 OUTSIDE WALL OPENINGS

A. Ducts:
   1. Pass through openings provided by Contractor.
   2. Size opening to allow approximately 1-inch clearance at all duct or duct covering surfaces.
   3. Provide sheet metal closures, insulation, calking, flashing and drip edges.
   4. Install to ensure 100% weatherproof construction.

B. Pipes:
   1. Pass through sleeves fabricated of Schedule 40 pipe cut 3/8-inch back from face of wall on each side.
   2. Sealed 100% watertight.
   3. Pipes below grade use cast iron sleeves.

3.4 FLOOR SLEEVES IN POTENTIALLY WET AREAS

A. All floors except slabs on grade.

B. Extend sleeves 3 inches above finished floor.

C. Provide poured concrete curb for duct openings as indicated in the Drawings.

3.5 ESCUTCHEONS AND CLOSURE COLLARS

A. Includes penetrations of ceilings, partitions, floor and walls.

B. Provide Escutcheons for All Piping Exposed to View:
   1. As indicated on the Drawings.
   2. Sized to fit over coverings.
   3. In All Potentially Wet Areas: Stainless steel.
   4. In All Dry Finished Areas: Chrome plated.
   5. Do not use escutcheons in acoustic isolation walls unless otherwise indicated.

C. Provide Sheet Metal Closure Collar for all Ductwork:
   1. Fit snugly around duct or covering, and surface penetrated without contact.
   2. Attach with approved fasteners 6-inch centers maximum spacing.
   3. Fabricate with minimum 4-inch face.

END OF SECTION 23 05 31

SECTION 23 05 46 – SOUND AND VIBRATION CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all equipment for and related items incidental to isolation and attenuation of mechanical vibration and sound:
   1. Major Items:
      a. Isolate mechanical rotating or vibrating equipment with vibration isolators.
      b. Connect ductwork and piping to equipment by means of flexible connections.
      c. Install mechanical equipment, piping and ductwork on, or suspended from, approved and specified foundations or supports.
      d. Install internal acoustical duct lining as indicated on Drawings or specified herein.
      e. Install duct silencers as indicated on Drawings or specified herein.
   2. All vibration isolation devices shall be furnished by a single Manufacturer.

B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   1. General Contractor: Provide concrete equipment pads.
   2. Mechanical Subcontractor:
      a. Provide miscellaneous structural steel necessary for support of mechanical work.
      b. Coordinate necessary alterations in structural steel.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASC – Adhesive and Sealant Council: A-7001C – Adhesives for Duct Liner.
   2. ASHRAE – 2015 Handbook – Table 47 of Chapter 48 – "Selection Guide for Vibration Isolation".
   3. ASTM:
      a. C423 – Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
      b. C665 – Specification for Mineral Fiber Blanket Thermal Insulation.
      c. C916 – Specification for Adhesives for Duct Thermal Insulation.
      d. C1071 – Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
      e. E84 – Test Method for Surface Burning Characteristics of Building Materials.
      f. E90 – Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
      g. E477 – Test Method for Measuring Acoustical and Air Flow Performance of Duct Liner Materials and Prefabricated Silencers.
      h. G21 – Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
      i. G22 – Practice for Determining Resistance of Plastics to Bacteria.
   4. NAIMA – North American Insulation Manufacturers Association: Fibrous Glass Duct Liner Standard.
   5. NFPA Standard:
      a. 90A – Installation of Air Conditioning and Ventilating Systems.
      b. 255 – Surface Burning Characteristics of Building Materials.
   6. SMACNA: HVAC Duct Construction Standards – Metal and Flexible.
   7. UL: 181 – Factory-Made Air Ducts and Air Connectors.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. The isolation materials Manufacturer shall be responsible for the proper selection of isolators to achieve the specified minimum static deflections, for all isolators, based on the actual weight distribution of equipment to be isolated.

B. The isolation materials Manufacturer shall be responsible for the structural design of steel beam bases and concrete inertia bases, to support mechanical equipment scheduled to receive such supplementary bases.

C. Be responsible for verifying the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this Specification. All additional equipment needed to meet the intent of this Specification, even if not specifically mentioned herein or in the Contract Documents, shall be supplied by the Contractor without claim for additional payment.

D. Sealing of Penetrations: Designated building structures designed to isolate air-borne noise surrounding all critical and noisy spaces. Proper routing of and sealing or lagging (enclosure), or both, around mechanical services penetrating these structures are necessary to maintain the integrity of the isolating structure.

E. Structural Isolation: Separations of building structures along acoustical joints have been designed to reduce structure-borne transmission of sound into critical spaces. Mechanical and electrical services must avoid rigid bridging across two structures isolated from each other.

1.5 NOISE CRITICAL SPACES

A. Many areas of this building require special attention (special acoustical provisions and restrictions) to the allowed background noise levels. The following areas are designated as “noise-critical” spaces:
   1. Mechanical Rooms.
   2. Kitchens.
   3. IT/AV Rooms.

B. Noise-critical walls are all walls enclosing the above spaces, and include spaces that contain noise producing equipment in addition to the “noise-critical” spaces listed above. Noise-critical slabs are those slabs (and all associated isolated ceilings or floating floor slabs) that are above and below rooms enclosed by noise critical walls.

C. Penetrations of noise critical walls and slabs by ducts, pipes, and conduit shall be sleeved, packed, and sealed airtight with non-hardening sealant as described in Division 23 Section “Penetrations for HVAC.”

1.6 SUBMITTALS

A. Manufacturer's Literature: For all products described under Part 2 of these Specifications.
   1. General:
      a. Dimensions.
      b. Construction details.
      c. Manufacturer's name.
      d. Model number.
   2. Spring Isolators:
      a. Rated deflection.
      b. Spring constant.
      c. Model number.
      d. Type of isolator.
      e. Size.
      f. Height when uncompressed and maximum allowed static deflection.
      g. Isolator location shown on an outline of the isolated equipment.
      h. Location of isolators on plan drawings of the isolated area, where applicable.
      i. The weight of all isolated equipment, and the loads on each isolator and the static deflection of each isolator under the specific design load shall be listed along with the proposed isolators.
      j. Pipe isolators shall be shown and identified on piping layout Drawings.

3. Duct Silencers and Duct Lining:
   a. Certified acoustical performance through octave bands from 63 Hz to 8000 Hz.
   b. Air pressure drop.
4. Duct Silencers:
   a. Submit test data from an independent laboratory showing the insertion loss and airflow-regenerated noise of the specified silencers in octave bands from 63 Hz to 8000 Hz, measured according to the duct to room method ASTM E477, or in duct intensity method. Pressure drop ratings shall be measured for the same silencer tested for acoustical performance, and the data shall be submitted with the acoustical performance data. The insertion loss of the silencers shall be measured with octave band or 1/3 octave band pink noise.
   b. Over extrapolation and data from out-dated equipment are unacceptable.
   c. These requirements apply to all duct silencers of the project, including those to be installed downstream of VAV terminal units.

B. Furnish a complete set of approved Shop Drawings of all mechanical and electrical equipment to receive vibration isolation devices to the vibration isolation materials Manufacturer, based upon the selection of vibration isolators and design of supplementary bases will be completed. The Shop Drawings to be furnished shall include operating weights of the equipment to be isolated and the distribution of weight at support points.

1.7 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Manufacturer or Qualified Representative Services:
   1. Provide necessary field supervision.
   2. Ensure correct installation and adjustment.

C. Regulatory Agencies Requirements:
   1. Comply with all state and local codes and ordinances.
   2. Insulation, facing, and adhesive shall have a composite rating:
      a. 25 flame spread maximum.
      b. 50 smoke developed maximum.
      c. In accordance with NFPA 255.
   3. Installation of acoustic duct liner shall be in accordance with:
      a. SMACNA – HVAC Duct Construction Standards – Metal and Flexible:
         1) Acoustical Liner Installation Standards.
         2) Mechanical Fastener Standard.
      b. NAIMA – Fibrous Glass Duct Liner Standards.

1.8 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Flexible Duct Connectors:
   1. Ventfabrics; "Ventglas and Ventsil".
   2. Duro Dyne; "Neoprene".

B. Vibration Control: All vibration control apparatus shall be provided by a single Manufacturer except as specifically noted herein:
   1. Amber-Booth.
   2. Mason Industries, Inc.
   3. Vibron.
   4. Kinetics.

C. Acoustic Duct Liner:
   1. Johns Manville; “Permacote Linacoustic Standard duct Liner”.
   2. Certainteed “Toughgard” with Enhanced Surface”.
   3. Equivalent by Knauf.
   4. Round Ductwork: Johns Manville; “Permacote Spiracoustic Plus Preformed Round Liner”.

D. Acoustic Duct Liner Adhesives:
   1. Foster Products.
   2. Childers.
   3. Baldwin-Ehret-Hill.
   4. Armstrong.
   5. Goodloe E. Moore.
   6. Precision Adhesive, Inc.
   7. Mon-Eco Industries, Inc.
   8. Johns Manville.

E. Duct Silencers:
   1. Industrial Acoustics.
   2. Koppers.
   3. United Sheet Metal.
   4. Gale.
   5. Aerosonics.
   6. Vibro-Acoustics.
   7. Titus.
   8. Price.

F. Acoustic Turning Vanes:
   1. Airsan Corporation; “Acoustiturn”.
   2. Engineer approved equal.

2.2 MATERIALS

A. Acoustic Duct Liner:
   1. Thermosetting resin bonded mat of dual density glass fiber coated on airstream side with an immobilized EPA registered anti-microbial agent.
   2. Density: 1.9 pounds/cubic foot.
   3. Thickness: 1-inch.
   4. Thermal Conductance (c): 0.24 at 75 degrees F mean temperature.
   5. Acoustical Performance:

Minimum Sound Absorption Coefficients at Octave Band Center Frequencies (Hz)						
125	250	500	1,000	2,000	4,000	NRC
0.09	0.29	0.67	0.89	1.03	0.99	0.70

   6. Facing:
      a. Factory-applied black acrylic coating.
      b. Fire-Resistant:
         1) Comply with NFPA 90A.
         2) UL listed.
         3) 25 flame spread and 50 smoke developed rating.

c. Rated for velocities at 5000 fpm tested in accordance with UL 181 without wearing of the surface or entrainment of glass fibers into air stream.
d. Designed to minimize friction loss.
e. The insulation must be resistant to microbial growth as determined by:
1) UL 181: Mold Growth and Humidity Test.
2) ASTM C1071: Fungi Resistance Test.
3) ASTM G21: Synthetic Material fungi Resistance Test.
4) ASTM G22: Synthetic Material Bacteria Resistance Test.

7. Use Johns Manville “Permacote Superseal” for edge coating and in areas requiring repair.

B. Round Acoustic Duct Liner:
1. Thermosetting resin bonded mat of dual density glass fiber coated on airstream side with an immobilized EPA registered antimicrobial agent.
2. Density: 1.9 pounds/cubic foot.
3. Thickness: 1-inch.
4. Thermal Conductance (C): 0.24 at 75 degrees F mean temperature.
5. Acoustical Performance:

Sound Attenuation dB/ft 1/3 Octave Band							
Inside Diameter (in.)	Frequency: Cycles per Second						
	125	250	500	1,000	2,000	4,000	8,000
8	0.4	1.3	3.3	6.1	7.1	4.8	2.2
12	0.3	0.8	2.2	5.1	5.7	2.0	1.3
16	0.2	0.6	1.7	4.2	2.8	1.5	1.3
20	0.1	0.6	1.9	4.1	1.5	1.1	1.1
24	0.0	0.3	1.3	2.6	1.3	1.0	0.9

6. Facing:
a. Factory-applied black acrylic coating.
b. Fire-Resistant:
1) Comply with NFPA 90A.
2) UL listed.
3) 25 flame spread and 50 smoke developed rating.
c. Rated for velocities at 5000 fpm testing in accordance with UL 181 without wearing of the surface or entrainment of glass fibers into air stream.
d. Designed to minimize friction loss.
e. The insulation must be resistant to microbial growth as determined by:
1) UL 181 – Mold Growth and Humidity Test.
2) ASTM C1071 – Fungi Resistance Test.
3) ASTM G21 – Synthetic Material Fungi Resistance Test.
4) ASTM G22 – Synthetic Material Bacteria Resistance Test.

7. Use Johns Manville “Permacote SuperSeal” for edge coating and areas requiring repair as required.

C. Duct Liner Fasteners:
1. Mechanically Secured:
a. 12-gage galvanized steel.
b. Impact-driven into duct.
c. Form positive mechanical attachment to sheet metal.
d. Fastener shall not compress the insulation more than 1/8-inch.
2. Weld-Secured:
a. Attached to Duct by:
1) Resistance welding.
2) Capacitance discharge welding.
b. Fastener Head:
1) 0.075 square inch minimum area.
2) 0.01-inch minimum thickness.
3) Cupped or beveled.
4) Shall not compress the insulation more than 1/8-inch.

D. Acoustic Duct Liner Adhesives:
   1. As recommended by Manufacturer of insulation.
   2. Solvent or water-based.
   3. Fire-resistant: 25 flame spread and 50 smoke developed rating.
   4. Comply with ASTM C916.
   5. Manufacturers:
      a. Foster 85-60 / 85-20.
      b. Childers CP-127 / CP-82.
      c. Duro-Dyne SSG.

2.3 VIBRATION ISOLATION EQUIPMENT

A. Flexible Duct Connectors:
   1. Flexible sleeves for duct connections shall be fabricated from flexible, airtight, coated fabric. Each sleeve shall be installed with at least 3 inches (75 mm) slack across a clear metal to metal gap of at least 4 inches (100 mm). That is, 7 inches (175 mm) of this fabric is required for each sleeve.
   2. Standard Temperature Type:
      a. Glass fabric, double coated with polychloroprene.
      b. Coated Fabric Weight: 30 ounces per square yard.
      c. Thickness: 0.024 inches.
      d. Temperature Range: -20 to 200 degrees F.
      e. Tensile Strength:
         1) 480 pounds per inch warp.
         2) 360 pounds per inch fill.
      f. Abrasion Resistance: 600 cycles.
   3. High Temperature Type:
      a. Glass fabric, silicone coated.
      b. Coated Fabric Weight: 16 ounces per square yard.
      c. Thickness: 0.017 inches.
      d. Temperature Range: -25 to 500 degrees F.
      e. Tensile Strength:
         1) 285 pounds per inch warp.
         2) 185 pounds per inch fill.
      f. Abrasion Resistance: 600 cycles.

B. Isolation Pads:
   1. Isolator Type WP:
      a. Type WP (waffle pads) shall be 5/16-inch (8 mm) thick neoprene pads, ribbed or waffled on both sides. The pads shall be selected for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad. Neoprene shall be bridge-bearing quality with a maximum durometer (Shore A scale) of 50.
      b. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
      c. Type WP: Mason Industries Type W; or as approved by Engineer.
   2. Isolator Type MWP:
      a. Type MWP (metal and waffle sandwich pads) shall consist of two 5/16-inch (8 mm) thick ribbed or waffle neoprene pads sandwiching a 16 gage stainless or galvanized steel shim plate. The pad shall be designed for 15% strain. Neoprene shall be bridge-bearing quality with a maximum durometer (Shore A scale) of 50.
      b. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660, or as approved) shall be installed under the bolt head between the steel washer and the base plate.
      c. Type MWP: Mason Industries Type WSW; or as approved by Engineer.

C. Isolation Hangers:
   1. Isolator Type DDNH:
      a. Type DDNH (double deflection neoprene hangers) shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene grommet extending from and continuous with the main neoprene element shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4-inch (19 mm) larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30-degree arc. When installed, the hanger box shall be allowed to rotate through a full 360 degrees without encountering any obstructions.
      b. Unless otherwise specified, the static deflection of DDNH hangers shall be 0.3 inches (8 mm) with a strain not exceeding 15%. Neoprene shall be bridge-bearing quality with a maximum durometer (Shore A scale) of 50.
      c. Type DDNH: Mason Industries Type HD; or as approved by Engineer.

D. Spring Isolators:
   1. Isolator Type SPNM:
      a. Type SPNM (spring and neoprene mounts) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between 1 and 2. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection. Unless otherwise specified, the minimum static deflection of SPNM isolators for equipment mounted on grade slabs shall be 1-inch (25 mm), and the minimum static deflection for equipment mounted above the lowest level (i.e., not on a grade slab) shall be 2 inches (50 mm).
      b. Two Type WP isolation pads sandwiching a 16 gage stainless or galvanized steel separator plate shall be bonded to the isolator baseplate.
      c. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660; or as approved) shall be installed under the bolt head between the steel washer and the base plate.
      d. Type SPNM: Mason Industries Type SLFSW; or as approved by Engineer.
   2. Isolator Type SPNH:
      a. Type SPNH (spring and neoprene hangers) shall consist of a steel spring in series with a neoprene isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches (8 mm) with a strain not exceeding 15%.
      b. Unless otherwise specified, the static deflection of SPNH hangers shall be 2 inches (50 mm). Neoprene shall be bridge-bearing quality with a maximum durometer of 50.
      c. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene grommet extending from and contiguous with the main neoprene element shall be provided where the hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger box. The diameter of the clear hole in the hanger box shall be at least 3/4-inch (19 mm) larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.
      d. Type SPNH: Mason Industries Type 30N; or as approved by Engineer.
   3. Isolator Type CSNM:
      a. Type CSNM (constrained spring and neoprene mounts) shall be a spring and neoprene mount that incorporates a housing which includes vertical limit stops to prevent spring expansion when weight (water or other fluid) is removed from the equipment and limits the movement of equipment when it is subjected to wind loading. A minimum clearance of 1-inch (25 mm) shall be maintained around restraining bolts and between the housing and the spring, so as not to interfere with the spring operation. Limit stops shall be out of contact during normal operation, backed away from contact by at least 1/2-inch (12 mm); a neoprene washer shall be installed beneath the bolt head/washer used to restrain the isolator. In outdoor rooftop installations isolators must be bolted to the roof or supporting structure with a neoprene mounting sleeve.
      b. Unless otherwise specified, the minimum static deflection for Type CSNM mounts shall be 2 inches (50 mm).
      c. Type CSNM: Mason Industries Type SLR; or as pre-approved by Engineer.

E. Pipe Flexible Connectors:
   1. Isolator type PFC (pipe flexible connectors) shall be Kevlar-reinforced neoprene, single or double-sphere design. Flexible connectors with control rods will not be permitted.
   2. Type PFC: Mason Industries “Safelex” Type SFEJ or SFDEJ.

F. Riser Guide for Isolated Pipework: Riser guides for isolated pipes shall be type DDNM isolators bolted to the vertical edge of a 90 degree steel angle. The guide shall allow the pipe to move axially, but shall limit lateral movement to approximately 1-inch (25 mm).

2.4 SOUND CONTROL EQUIPMENT

A. Duct Silencers:
   1. Rectangular duct silencers shall have outer casings of not less than 22 gage galvanized steel. Seams shall be lock-formed and mastic filled. The internal baffles (splitters) shall be not less than 24 gage galvanized perforated steel having an open area of 25% to 40%.
   2. The nosings shall be full radius or airfoil shape. The sound absorbing media shall be not less than 4.5 pounds/cubic feet (75 kg/cubic meter) glass/mineral fiber packed under 5% compression. The fiber fill shall be incombustible, mildew-resistant, and vermin-proof. The sound absorbing material shall be protected from erosion.
   3. If the silencer is supplied in modular sections, the silencer shall meet or exceed the specification for single-module silencers with respect to insertion loss, pressure drop, regenerated noise and air leakage.
   4. Silencer rating shall be determined in a duct to reverberate room test facility which provides for air flow through the silencers during ratings. The test set-up and procedure shall be such that all effects due to end reflection directivity, flanking transmission, standing waves and test chamber sound adsorption are eliminated. Acoustic rating shall include Dynamic Insertion Loss and Self Noise Power Levels both at 2000 fpm face velocity.
   5. The insertion loss of each silencer shall be as indicated in the schedule. Unless otherwise specified, the sound power insertion loss of the duct silencers shall be not less than the following values at an air velocity of 1000 fpm in the direction of sound propagation.

1/3 Octave Band Insertion Loss in dB at the Following Frequencies			
Silencer Length	63 Hz	125 Hz	250 Hz
3 feet (1.0 M)	4	7	12
5 feet (1.5 m)	6	10	18
7 feet (2.1 m)	10	14	24
10 feet (3.0 m)	12	20	34

   6. Unless otherwise specified, the pressure drop across the duct silencers shall not exceed the following values:

Pressure Drop (w.g.) for Air Velocity	
Silencer Length	1,000 FPM (5 m/s)
3 feet	0.16 inch (4 mm) (39.8 Pa)
5 feet	0.17 inch (4 mm) (42.8 Pa)
7 feet	0.20 inch (5 mm) (49.8 Pa)
10 feet	0.20 inch (4 mm) (49.8 Pa)

   7. Unless otherwise specified, the self-noise of the duct silencers shall be not more than the following values at an air velocity of 1000 fpm in the direction of sound propagation:

Octave Band Self-Noise Power Levels in dB at the Following Frequencies			
Face Area	63 Hz	125 Hz	250 Hz
1 sf 02 m^2	38	26	30
2 sf 02 m^2	41	29	33
4 sf 04 m^2	44	32	36
8 sf 08 m^2	47	35	39

B. Acoustic Turning Vanes:
   1. Construction:
      a. Double wall made of 1-1/2 pound density fiberglass rated for 4,000 fpm.
      b. Minimum 24 gage galvanized steel side rails and perforated inner face.
      c. Minimum 14 gage aluminum outer wall.
      d. Reinforce turning vanes in ducts over 24 inches by rods or sectional construction to limit unsupported length to 24 inches.
   2. Use “Acoustiturn” model with adjustable vanes and split rails at elbows where the duct size changes.

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 2 inches (50 mm) between the bottom of the equipment or inertia base (and height-saving bracket) and the concrete housekeeping pad (or bolt heads, whichever is closest) beneath the equipment. The clearance shall be checked to ensure that no scraps have been left to short-circuit the vibration isolators. There shall be a minimum 4-inch (100 mm) clearance between isolated equipment and the walls, ceiling, floors, columns, and any other equipment not installed on vibration isolators.

B. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes, or ductwork installed on vibration isolators. It shall be supported on or suspended from building structure.

C. Equipment connected to fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping. Equipment should be blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims, and confirm that the isolators for the fluid-filled pipes, pumps, and other elements deflect the specified amounts and no more.

D. All mechanical equipment not specifically identified in this Specification that contains rotating or vibrating elements, and all associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM or RBA neoprene isolators as appropriate. In all such instances, submit the proposed isolators with the isolator Shop Drawings.

E. All isolators that are to be installed outdoors or exposed to the weather shall be hot-dipped galvanized and shall be furnished with neoprene mounting sleeves for hold-down bolts to prevent any metal-to-metal contact.

F. Elastomeric isolators that will be exposed to temperatures below 32 degrees F (0 degrees C), shall be fabricated from natural rubber instead of neoprene.

G. Wiring:
   1. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 36-inch (1 m) long flexible conduit in a 360-degree loop.
   2. All ties used to form the loop shall be removed prior to adjusting the isolators.

3.2 PUMPS

A. Inline Pumps:
   1. Inline pumps 1.5 hp (1.1 kW) and greater shall be supported by the piping which is isolated on Type SPNH isolators. If support is required below the pump, the pump shall be supported on Type SPNH or SPNM spring isolators as appropriate.
   2. Inline pumps less than 1.5 hp (1.1 kW) and adjacent pipework shall be supported on neoprene isolating hangers Type DDNH, unless other provisions of this Specification or the schedule call for greater deflection.

3.3 FAN ISOLATION

A. Rooftop Units and Air Handling Units:
   1. Units with internal spring isolation and installed on grade shall rest on type MWP neoprene sandwich pads on a concrete housekeeping pad.
   2. Drain pipes shall be supported only from the isolated unit frame.

B. Fan Coil Units: Fan coil units suspended from overhead structure shall be hung on Type SPNH spring-neoprene isolators. Unless otherwise specified in the Schedule, the static deflection of the isolators shall be 1-inch (25 mm). Wall or floor-mounted fan coil units shall not be employed inside the quiet zones or acoustically critical rooms.

3.4 PIPE ISOLATION

A. Pipes Connected to Equipment on Spring Isolators:
   1. All pipes connected to equipment installed on spring vibration isolators shall be suspended, supported, and guided for at least 30 feet by means of appropriate spring vibration isolators as described below. This includes, but is not necessarily limited to heating pipes. Pipes shall be supported by Type SPNM isolators or hung from the structure on Type SPNH isolators.
   2. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches (50 mm). The static deflection of the remaining pipe isolators shall be 1-inch (25 mm).

B. Pipes Connected to Equipment on Neoprene Isolators: Piping that is connected only to machinery installed on neoprene isolators shall be either supported from the floor on Type DDNM mounts or suspended from the structure on Type DDNH hangers.

C. Pipes With Multiple Connections: Where a pipe run connects multiple items of equipment in the mechanical room, the pipe isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

D. A flexible connector shall be installed to connect a pipe on isolators to a piece of equipment on isolators of less static deflection than the pipe.

E. Small HVAC Water Pipes
   1. Except as noted, all HVAC pipes with a diameter less than or equal to 2 inches (50 mm), shall be located on DDNM and DDNH isolators.
   2. When it is compressed, the sleeve shall be not less than 1/8-inch (3 mm) in thickness. This provision shall apply to all piping not otherwise required to be installed on vibration isolators. Note that pipes crossing structural joints shall be isolated as described above.

F. Pipe Risers: Where pipes rise in a vertical chase, are supported from a structure with Type SPNH or DDNH isolators, and require lateral bracing, neoprene riser guides shall be mounted around the pipe to limit lateral movement and to prevent direct contact with the supporting structure.

G. Pipes Crossing Acoustic Joints:
   1. All pipe crossing a building acoustic joint shall have a twin-sphere neoprene flexible connector at the joint, with the exception of piping associated with fire protection, gas and compressed air, and shall be suspended by Type SPNH isolators as follows:
      a. Pipes with an inner diameter less than 2 inches (50 mm) shall be suspended by SPNH isolators for a minimum distance of at least 30 feet (10 m) on each side of the joint.

3.5 SHEET METAL DUCTWORK

A. Duct Isolation:
   1. All ducts shall be supported on either Type SPNM or Type SPNH isolators for a minimum of 25 feet times the maximum duct dimension after the rooftop unit. For roof exhaust fans, the duct shall be isolated at the first three points of support.

2. Where a duct crosses an acoustic joint in the structure, the duct shall be supported on neoprene hangers or mounts for a minimum of 5 times the outside duct height on each side of the joint. Otherwise, no duct isolators are required outside the mechanical room unless indicated on the Drawings.
3. Ducts shall be connected to fans, fan casings, and rooftop units by means of flexible connectors.

B. Duct Silencers:
1. Duct silencers shall be furnished and installed as indicated on the Drawings and as called for in the silencer schedule.
2. The governing parameters for silencer selection are insertion loss, pressure drop, and self-noise; these data shall appear for each silencer on the Project. The Manufacturer shall demonstrate how the data was measured and derived; over-extrapolation is unacceptable.
3. The clear inner dimensions of the duct silencer shall match the clear inner dimensions of the ductwork to which it is attached.

C. Ductwork Fabrication: Fabricate ductwork so as to be free from vibration, rattle, or drumming under all operating conditions; provide all materials necessary for specified construction, whether or not they are specifically called for or detailed on the Drawings.

D. Bracing of Ductwork: Do not install tie rods inside ducts.

E. Ductwork Wall Penetrations: Seal around ductwork wall penetrations as specified in Division 23 Section "Penetrations for HVAC."

3.6 ACOUSTIC LINING OF DUCTS

A. Application:
1. Ductwork, except where noted otherwise, to be lined:
   a. Both supply and return systems from package rooftop units for the first 20 feet.
   b. All ductwork used exclusively to transfer air connected to one room to another.
   c. Ducts serving or routed above noise-critical spaces.
   d. Where indicated on the Drawings.
2. Ductwork Not to be Lined:
   a. Outside air intakes.
   b. Relief air ductwork.
   c. Exhaust ductwork.
   d. All ductwork conveying or potentially conveying unfiltered or untempered outside air or mixed air.

B. Thickness:
1. Lining shall be 2 inches (50 mm) thick in ducts servicing the first 20 feet of supply and return ductwork, 1-inch (25 mm) thick in all other internally lined sheet metal ducts, unless otherwise specified or indicated on the Drawings.
2. Where internal lining is also specified in Division 23 Section "Duct Insulation" for thermal duct lining, the greater thickness shall be used.

C. Where round ductwork is to be internally lined, a double wall duct system with perforated inner wall as specified in Division 23 Section "Metal Ducts" may be used.

D. Installation:
1. The acoustic liner shall be fixed to the duct with a minimum of 50% coverage of a fire-resistant adhesive. All perimeter acoustic liner edges shall be coated with adhesive.
2. Where the duct width exceeds 12 inches (300 mm) or a height of 24 inches (600 mm), the liner shall be additionally secured with mechanical fastening on maximum 16-inch (400 mm) centers, and no more than 3 inches from ductwork edges or insulation joints.
3. Mechanical fasteners that pierce the duct are unacceptable.
4. All portions of duct specified to receive acoustic liner shall be completely covered.
   a. Transverse joints shall be neatly butted and there shall be no interruption or gaps.
   b. All transverse edges are to be 100% covered with Manufacturer-supplied edge coating.
   c. Cut liner to ensure tight corner joints.
   d. All corner joints are to be either lapped and butted, or folded.

e. Black coated surface is to face air stream.

5. Acoustic liner shall be 100% covered with Manufacturer supplied coating at all exposed surfaces, edges, and transverse joints.
6. Where acoustic duct lining is installed, the dimensions of the sheet metal shall be increased to include the thickness of the lining material. Dimensions indicated on the Drawings are the net clear internal dimensions after the acoustic liner has been installed.
7. Exposed and leading edges will be covered with metal nosing around the entire perimeter.
8. Round acoustic liner shall be slid into round metal ducts in accordance with Manufacturer's instructions.

3.7 MISCELLANEOUS EQUIPMENT

A. Expansion Tanks:
1. Each floor-mounted unit shall be supported on Type MWP neoprene sandwich pads. Each suspended unit shall be supported on Type DDNH hangers. Where piping on isolators is connected to these units, the connection shall be made with a neoprene flexible connector.

B. Flexible Duct Connectors:
1. Install at duct connections to air moving equipment.
2. Install at locations indicated on Drawings.

C. Acoustic Rooftop Unit Isolation: Install at all packaged rooftop units.

3.8 FIELD QUALITY

A. Work in accord with best trade practices, fabricate and install all items in accordance with Manufacturer’s recommendations and Engineer’s directions, and consult with trades doing adjoining work in order to provide an installation of first class quality.

3.9 ADJUSTMENT AND TESTING

A. Vibration Isolation Report:
1. The vibration isolation Manufacturer shall inspect and approve the installation of the vibration isolators and shall submit a report to Engineer which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the Specification.
2. The report shall record the model or type of each isolator.

B. Site Access: During installation of equipment, arrange for access as necessary for inspection of isolation and noise control equipment by Engineer.

C. Inspection:
1. Upon completing installation and adjustment for suitable operation of all work specified under this Section, notify Engineer in writing, who will schedule a review.
2. The Contractor’s letter shall certify that all work specified under this Section is complete, operational, and adjusted in every respect, and that all work under this Section is ready for the completion checkout.
3. The notification letter shall be accompanied by a copy of the air balancing report.
4. For each inspection, workmen shall be furnished to perform such functions as are necessary for inspection of the equipment.
5. Measurement of background noise levels by the Engineer requires that there be a minimum of extraneous noise.
6. Such measurements must be scheduled during late-night hours when there is no work taking place on the Site.
7. Workmen shall be employed during the testing procedure to turn on and off all mechanical and electrical equipment for such background noise level testing.

END OF SECTION 23 05 46

SECTION 23 05 73 – TESTING AND CLEANING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes providing testing and cleaning services and the major items listed below:
   1. Provide all pumps, gages, valves and other equipment and material necessary to properly conduct tests and perform cleaning.
   2. Provide all equipment, material, labor and testing required to properly pacify hydronic system piping so that it may be integrated into the existing hydronic system with no adverse effects or contamination.
   3. Arrange and pay for all costs of utilities and chemicals required for the Work.
   4. Repair and Restore All Work Damaged:
      a. By tests.
      b. By cutting required in connection with the tests.

1.3 REFERENCES

A. American National Standards Institute/Institute of Inspection Cleaning and Restoration Certification (ANSI/IICRC).
   1. ANSI/IICRC S520 – Standard for Professional Mold Remediation.

B. National Fire Protection Association (NFPA) Standards:
   1. 90A – Installation of Air-Conditioning and Ventilating Systems.
   2. 90B – Installation of Warm Air Heating and Air-Conditioning Systems.

1.4 SUBMITTALS

A. Flushing and Cleaning:
   1. Submit certificates for all code-required inspections.
   2. Submit all water Sample analysis reports as required in Part 3 of these Specifications.

B. Pressure Test Reports:
   1. Submit within 1 week after each system pressure test.
   2. List time, date and persons present for the following for each system:
      a. Initial tests.
      b. Final test.
   3. Include report indicating:
      a. Test type and duration.
      b. Initial pressure.
      c. Final pressure.
   4. Indicate that necessary repairs and final tests were satisfactorily completed.

1.5 QUALITY ASSURANCE

A. Comply with all applicable codes.

B. Secure State Health Department approval for potable water systems.

C. Testing and Cleaning Agency:
   1. Minimum 15 years' experience in providing cleaning chemicals for water systems use.
   2. Provide regional laboratory support services.

PART 2 - PRODUCTS

2.1 CLEANING AGENT MANUFACTURERS

A. Aqua-Chem.

B. Aquatrol.

C. Enerco.

D. Nalco.

2.2 MATERIALS

A. Detergents, solvents, and other cleaning agents shall be compatible with materials of fabrication of systems where they are used. No cleaning agent shall adversely affect materials or mechanisms in systems and cleaning agents shall be acceptable to equipment manufacturers and the Owner's environmental coordinator.

B. Detergents, solvents, and other cleaning agents shall be compatible with process streams to be handled by systems in which the cleaning agents are used.

C. Owner will provide water for cleaning and flushing. Other cleaning fluids, agents, and equipment shall be provided by Contractor.

D. Hydronic systems shall use the following products or an equal substitute and shall be approved by the Engineer prior to flush.
   1. Use a nitrite based solution, as recommended by Manufacturer, prior to any other for the removal of iron oxides from the metal surfaces, and passivation of the base metal.
   2. The solution shall be circulated until a steady iron concentration is reached in the circulating water. As the solution dissolves iron oxide deposits, ferric hydroxide is formed and the pH rises it is necessary to maintain a pH range of 9 to 9.5. Therefore, supplemental feeding of the solution may be required in extremely dirty systems.
   3. A sodium nitrite based corrosion protection shall be placed in the pacified pipe after the system has been cleaned and flushed.

E. Provide all necessary temporary equipment required for cleaning and flushing operations.

F. Pipe Cleaning:
   1. Provide permanent hose connections for supply, discharge and recirculating lines for the new piping system.
   2. Provide piping at the ends of the main and branch lines of the piping system as required to accomplish flush of the piping.
   3. Provide a temporary pump of sufficient head and GPM required to achieve a flushing velocity of at least 10 feet per second.
   4. Provide temporary chemical skids with tote tanks as required for mixing chemicals and serving as a source reservoir and/or collection point for cleaning and flushing solutions.
   5. Provide temporary bag filters (with filter bags) as required for removal of contaminants from flushing process.
   6. Provide all hose, electrical leads and supply connections for completion of system required to fill, drain and refill of the lines utilizing plant supplied water and power.

PART 3 - EXECUTION

3.1 PIPING SYSTEM PRESSURE TEST

A. General:
1. Perform all tests before piping is painted, covered, concealed or backfilled.
2. Before testing, remove or otherwise protect from damage, control devices, air vents, fixtures, meters, or other parts which are not designated to withstand test pressures.

B. Test Procedures:
1. Air Test:
a. Charge with air to the test pressure specified.
b. When possible, perform test when ambient air temperature is constant.
2. Soap Test:
a. Charge with air, water or carbon dioxide to pressure specified.
b. Examine all joints for leaks with a soap suds solution.
3. Water Test:
a. Charge with water to the pressure specified.
b. Exterior Surface of Pipe and Fittings:
1) Show no cracks or other form of leaks.
2) Completely drip dry.

C. Pressure Test Criteria:
1. Test criteria below are minimum requirements. In addition, the requirements of State and Local Codes having jurisdiction shall be met:

Piping System	Type Test	Pressure	Allowable Pressure Drop	Minimum Test Duration
Drainage System	Water	5 psig	0 psi	30 Minutes
Hydronic	Water	100 psig	2 psi	8 Hours

3.2 REFRIGERANT SYSTEM TESTING AND EVACUATION

A. Each Air Conditioning System:
1. Pressure Test:
a. Pressure test using nitrogen (N_2) gas.
b. Pressurize the system to 25 psig.
c. Check for leaks.
d. Once the system is tight, pressurize with additional nitrogen and small amount of refrigerant to obtain minimum rated design pressure.
e. Hold this pressure for 12 hours.
f. Notify Engineer 24 hours in advance of test.
2. Evacuation:
a. Evacuate to 500 microns (reading must be taken from a system point furthest away from the vacuum pump).
b. Hold for 12 hours with the pump isolated.
c. Must be witnessed and approved by Engineer's representative prior to breaking the vacuum.
d. On large systems, evacuation may be done in sections, as long as positive isolation can be achieved.

B. Ensure maximum cleanliness of all refrigerant piping.

C. Dehydrate piping in an approved manner.

D. Do not cover or anchor piping until testing is complete and all leaks properly eliminated.

3.3 PIPE FLUSHING AND CLEANING PROCEDURES

A. Prior to Flushing:
   1. Remove orifice plates, traps, strainer elements, flow control valves, etc. prior to or during process of cleaning. Remove instruments which might be damaged by cleaning procedures. Replace such items with spool pieces, plugs, or blind flanges. A "blind list" shall be prepared listing where blinds have been installed for cleaning and shall be provided to Owner after cleaning is complete to verify that all blinds have been removed.
   2. Items removed from piping system shall be cleaned separately.
   3. Lock valves in open position.
   4. Use new gaskets and thread lubricants when removed items are reinstalled after cleaning.
   5. Temporary Bypass Piping: Provide full size bypass piping and valves at coils and heat exchangers such that the coils and heat exchangers can be isolated.
   6. Temporary Strainers: Disconnect piping to be flushed from equipment or install temporary strainers immediately upstream of such equipment.

B. System Protection:
   1. Protect piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during flushing and draining procedures.
   2. Exercise special care with polyvinyl chloride (PVC) and fiberglass-reinforced plastic (FRP) piping and upon initial filling of long pipe runs to determine that pipe is in contact with hangers and supports before filling. Piping bowed out of hangers or supports will settle or lengthen during filling and resulting forces may be damaging at changes in direction.
   3. Install high point vents and low point drains required to remove trapped air and to drain flushing liquid.

C. Hydronic Piping Systems Flushing and Cleaning:
   1. Thoroughly flush with water to remove pipe dope, slushing compounds, oils, welding slag, loose mill scale and other extraneous materials. Open all valves to ensure cleaning of entire system.
   2. Apply detergent and operate system in accordance with water treatment service organizations recommendations, circulating for a minimum of 8 hours:
      a. Use only equipment and chemicals furnished by a qualified water treatment service organization.
      b. Determine loop capacity by metering fill with all air bled out.
      c. Isolate alkaline cleaners from cooling towers and aluminum and galvanized surfaces.
      d. Place all control valves in open position for filling and venting.
   3. Flush through the piping mains from the extreme end to extreme end of the system until solution is well mixed and stable. Recirculate the water through the piping system until the desired cleanliness has been achieved. If the water is very dirty and the tote tank does not provide enough settling time to remove the debris prior to being suctioned out by the Contractor provided recirculation pumps, install a temporary bag housing with a filter or wire mesh strainer in the flowpath.
   4. After the mains have been flushed, flush the branch lines starting with the branch closest to the supply point and progress toward the extreme end of the piping that is furthest from the source. Repeat the flushing through each branch until the desired cleanliness has been achieved.
   5. Collect water samples and label them with a location and time/date, for analysis of cleanliness. Continue to sample the new piping system piping until it is completely flushed clean of all contaminants and matches the influent source for cleanliness.
   6. When desired cleanliness has been achieved, drain all flushing water from the system and then refilled, circulated throughout the mains and branches to rinse out the flushing chemicals, and dumped again.
   7. Restore all piping to its design state (remove all temporary piping and close all valves), and refill the system with water and the proper amount of pacifying chemical as directed by the chemical supplier. Recirculate the chemicals throughout the system for a sufficient amount of time as the chemical supplier requires for proper mixing and metal exposure.
   8. Drain the system, refill with water and coordinate with the Owner to open the new piping to the existing hydronic system for final mixing of Owner's chemical into the newly refilled piping via the existing system pumps and chemical injection system.
   9. In the event that the new piping is not to be integrated into the existing hydronic system for more than a month, coordinate with the Owner as to whether the system is to remain in "wet layup" with the pacifying chemicals in place or "dry layup" in which case the piping is to be drained and a nitrogen purge applied
   10. Drain the system, refill with water and Owner furnished chemicals as directed by the Owner.
   11. Process Fluids piping shall be placed in "dry layup" as specified.

12. After the system has been cleaned:
    a. Test water Sample and submit analysis to Engineer.
    b. Water Sample shall exhibit neutral pH and no turbidity.

3.4 CLEANING AND FINISHING

A. Comply with the requirements of Division 01 Section “Cleaning and Waste Management.”

B. After tests have been made and the system pronounced tight:
    1. Clean piping and equipment.
    2. Lubricate bearings.

C. Final cleaning includes but is not limited to the following:
    1. Equipment with Factory Finishes:
        a. Wash factory-finished equipment with mild soap and water and leave in first-class condition, entirely free of stains or streaks.
        b. Do not use abrasive materials.
        c. Touch up scratches or other violations of the factory finish paint with matching paint from the equipment Manufacturer.

END OF SECTION 23 05 73

SECTION 23 05 93 – TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes a description of the mechanical system testing, adjusting and balancing (TAB) scope of services. The following systems shall be included in the testing, adjusting, and balancing process:
   1. Hydronic distribution systems.
   2. Air handling/air distribution systems.
   3. Exhaust systems.
   4. Variable frequency drives.
   5. Domestic hot water recirculation systems.
   6. Boilers.

B. Division of Work:
   1. In accordance with the General Conditions, Contractor shall be responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.
   2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
      a. Mechanical Subcontractor:
         1) Provide related work as specified herein to support the mechanical systems TAB work being performed by TAB engineer.
         2) Provide access to all balancing devices.
         3) Perform system start-up functions including, but not necessarily limited to:
            a) Venting air from all hydronic system piping and components.
            b) Setting all manually operated dampers and valves in the full open position.
            c) Complete and submit pre-test and balance checklist to Engineer and TAB engineer prior to start of TAB work.
         4) Correct all mechanical system deficiencies identified by TAB engineer.
      b. TAB Engineer:
         1) Provide timely notice to mechanical Subcontractor, TCS Subcontractor and Commissioning Provider of all incomplete work and deficiencies which prevent proper performance of test and balance work.
         2) Test, adjust and balance all air and hydronic systems and prepare final report.
      c. Temperature Control System (TCS) Subcontractor:
         1) Provide related work as specified herein to support the mechanical systems TAB work being performed by TAB engineer.
         2) Operate all temperature control devices to support TAB work that is dependent on various control operating modes.
         3) Correct all TCS system deficiencies identified by TAB engineer.
      d. Commissioning Provider: Provide verification of system function in conformance with design intent, including systems balance and adjustment, and controls function.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. Sheet Metal and Air Conditioning Contractor's Association (SMACNA) publications:
      a. Procedural Standards for Testing, Adjusting, and Balancing of environmental systems.
      b. Procedural Standards for Measuring Sound of Vibration.
      c. Testing, Adjusting, Balancing Manual for Technicians.
   2. Associated Air Balance Council (AABC): National Standards for Total System Balance, 2002 Edition.

3. National Environmental Balancing Bureau (NEBB): Procedural standards for testing, adjusting, and balancing of environmental systems.
4. Testing, Adjusting, and Balancing Bureau (TABB): TAB Procedural Guide.

1.4 DEFINITIONS

A. Proper Performance Characteristics:
1. In accordance with design intent, acceptable energy efficiency and Manufacturer's recommendations.
2. Providing acceptable thermal and acoustical performance in all service areas.
3. As directed by Engineer.

B. TAB Engineer: An individual, firm or corporation whose primary work is testing, adjusting and balancing environmental systems working under a direct contract to the Contractor.

1.5 SUBMITTALS

A. Submit Pre-Test and Balance Checklist and mechanical systems TAB report in accordance with Division 01 Section “Submittal Procedures.”

B. Submit Pre-Test and Balance Checklist at least 2 weeks prior to scheduled start of TAB work as scheduled by Contractor and approved by Owner.

C. Preliminary TAB Submittal:
1. Prior to final inspection.
2. A pdf file to Engineer.
3. A pdf file to mechanical commissioning provider: As soon as possible after balancing work to facilitate spotchecking.

D. Final Submittal: A pdf file to Engineer.

E. The TAB report shall include, but not necessarily be limited to, the following general items:
1. Summary remarks regarding problems.
2. Initial, interim and final performance test data.
3. Description of test procedures and equipment used.
4. Systems' Drawings and/or schematics clearly marked to identify location of equipment tested, duct traverse location(s), location of system static pressure sensor, etc.
5. Systems performance data sheets shall include design conditions, installed equipment information, and field test data for:
   a. Air Systems:
      1) Design Conditions:
         a) Air capacity.
         b) System total static pressure drops and profiles of all air handling systems, including filters, coils, etc.
         c) Motor horsepowers and design brake horsepowers.
         d) Fan speeds.
         e) Fan curves or fan rating tables showing design conditions.
      2) Installed Equipment:
         a) Equipment Manufacturer.
         b) Equipment model numbers, sizes, types, etc.
         c) Motor types, sizes and characteristics.
         d) Heater and starter types, sizes and characteristics.
         e) Drive types, sizes and speed range.
         f) Equipment ratings if different from design.
         g) Identification of all terminal devices, including outlets.
         h) Location of all smoke control devices.
      3) Field Test Data – Initial and Final Test Readings For:
         a) Air capacities.
         b) Static pressures through units and unit components.
         c) Equipment speeds.

d) Motor operating voltages and amperages.
e) Brake horsepower.
f) Operating performance plotted on fan curves or fan rating tables.
g) System schematic and notes including measured static pressure values, system static pressure sensor values, etc.
h) Airflow and static pressure data for all duct mains as balanced under typical total system operation. Report will not be accepted without airflow and static pressure profile (refer to Paragraph 3.3).
i) Identify each outlet or inlet as to location, area, size and fan system.
j) Required and field measured cfm for each outlet or inlet.
k) Identify each smoke control device and pressure differential and flow test data.

b. Hydronic Systems:
1) Design Conditions:
a) Water flow rates.
b) Pump TDH and speed.
c) Motor horsepower and design brake horsepower.
d) Pressure drops through coils, heat exchangers, etc.
e) Pump curves showing design conditions.
2) Installed Equipment:
a) Equipment Manufacturer(s).
b) Equipment model numbers, sizes, types, etc.
c) Motor types, sizes and characteristics.
d) Heater and starter types, sizes and characteristics.
e) Equipment ratings if different than design.
3) Field Test Data – Initial and Final Test Reading For:
a) Pump pressures at full flow and at shut-off.
b) Pump motor operating voltages and amperages.
c) Flow rates through all flow indicators.
d) Positions of balancing valves.
e) Suction pressure, discharge pressure and pressure drops through all heating and cooling equipment pieces.
f) Brake horsepower.
g) Operating performance plotted on pump curves.

c. Domestic Hot Water Systems:
1) Design Conditions:
a) Water flow rates.
b) Pump TDH and speed.
c) Motor horsepower/KW.
2) Installed Equipment:
a) Equipment Manufacturer(s).
b) Equipment model numbers, sizes, types, etc.
c) Motor types, sizes and characteristics.
d) Heater and starter types, sizes and characteristics.
e) Equipment ratings if different than design.
3) Field Test Data – Initial and Final Test Reading For:
a) Pump pressures at full flow and at shut-off.
b) Pump motor operating voltages and amperages.
c) Flow rates through all flow indicators.
d) Positions of balancing valves.
e) Suction pressure and discharge pressure.
f) Operating horsepower/KW.
g) Operating performance plotted on pump curves.

1.6 QUALITY ASSURANCE

A. Qualifications:
1. TAB Field Technician Personnel:
a. Trained and experienced in the operation of the test and balance equipment.
b. Knowledgeable of the design of all systems scheduled for testing and balancing.

2. TAB Engineer:
   a. A certified member of either the following organizations or trained in the practices thereof:
      1) AABC.
      2) NEBB.
      3) TABB.

B. Report Forms:
   1. The report forms included in the appendix of the AABC Standard are incorporated in the work of this Section for the purpose of identifying the level of detail required for testing and reporting.
   2. TAB engineer may use the AABC forms or other similar forms which present equivalent information in a logical format.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Patching Materials:
   1. Comply with requirements as specified in other Sections where applicable to provide materials essentially and functionally identical to original installation before testing and balancing work.
   2. Maintain the integrity of systems for air tightness, water tightness, and durability of finish.

2.2 INSTRUMENTS

A. Instruments used for TAB work shall be as indicated in the referenced standards.

B. Calibration:
   1. Instruments to have been calibrated within one year of start of TAB work.
   2. Appropriate documentation shall be made available to the Engineer on request.

PART 3 - EXECUTION

3.1 PROCEDURES

A. General:
   1. Determine what actual performance characteristics are deemed proper during system tests.
   2. If the design supply, return or exhaust air quantities for a space create a space pressure other than neutral, or if a space is indicated to be a certain pressure, provide balancing to the extent required to achieve this designed pressure.
   3. During heating (and cooling) season of the first year of operation, at times when directed, make final adjustments until all occupants are reasonably satisfied and all equipment is operating at peak efficiency.
   4. Confirmation of proper equipment operation must be through actual observation. Computer simulation and sensor readouts are not acceptable proof.
   5. Air quantities at individual registers or diffusers shall be adjusted to within 10% of quantities indicated on the Drawings and total air quantity handled by each system to within 5% of the quantity indicated or specified. Water systems balance to within 5% of the quantity indicated or specified.

B. Air Systems:
   1. General:
      a. Adjust and set all dampers, deflecting vanes, discharge vanes and accessory items to achieve proper air distribution and patterns in all parts of the air supply, return and exhaust systems:
         1) Determine air flow and static pressure in all branch ducts by velocity traverse and balance out all branches by means of branch duct manual dampers.
         2) Balance terminal outlets on each branch duct using volume dampers in run-out duct to the outlet, not the terminal outlet dampers.
      b. Mark final balance position for all dampers which are not left 100% open with an indelible pen.
      c. Adjust and set all belted fan speeds as required to attain proper total air flow.
      d. Measure supply fan total air flow at both the full return air and full outdoor air damper positions.

e. Make smoke gun tests, if necessary, to check for drafts and make final adjustments and settings for optimum comfort conditions.

2. Methods: Acceptable procedures for obtaining performance measurements are listed below:
   a. CFM Airflow for Duct Sections:
      1) Duct traverse as specified in SMACNA Manual "HVAC Systems – Testing, Adjusting and Balancing," Chapter V, Section 4-B, using a pitot tube and inclined manometer.
      2) Acceptable Methods:
         a) Pitot tube array with reading by inclined manometer.
         b) Electronic manometer.
         c) Hot-wire anemometer.
   b. CFM airflow, for room supply, return and exhaust, at diffusers, registers and grilles: Use airflow hood.
   c. Fan TSP: Use electronic manometer or inclined manometer.
   d. Equipment Pressure Drops: Use electronic manometer or inclined manometer.
   e. Air Temperatures: Use thermometer.
   f. Smoke Testing: Use a non-hazardous material.
   g. CFM Differential Airflow Reading:
      1) Block door entrance leaving 1 or 2 square foot measured opening.
      2) Read opening with thermal anemometer.
   h. Differential Pressure: In cases where sensors for differential pressure are permanently installed, differential pressure may be read directly using an Electronic Digital Manometer.
3. TAB Procedures for Air Systems:
   a. Check all motorized, balancing and gravity relief dampers for proper position.
   b. Inspect coils, filters and fans for cleanliness.
   c. "Bump" motor to check for proper fan rotation.
   d. Check unit performance including:
      1) Fan speed.
      2) Amperage and voltage.
      3) Inlet, discharge and total static pressures at fan.
      4) Air volume of fan by taking duct traverse in discharge duct or zone ducts.
   e. Note: Check unit performance in both 100% outside air and 100% return air positions, including static pressures across individual equipment components.
   f. Set outside air motorized damper at proper minimum position.
   g. See that necessary adjustments or changes are made to achieve design airflow capacities or consult Engineer if change(s) required are beyond the scope of the TAB contract.
   h. Balance Medium and High Velocity Ductwork:
      1) Measure inlet static pressure and airflow at all terminal unit inlets through actual transverse. Flow sensor readings are not acceptable.
      2) If terminal unit has constant volume regulator or manual adjustment damper, make certain the correct maximum amount of air is being delivered.
      3) All measurements should be taken only when system is operating under normal operating conditions.
      4) If system is variable volume, set up diversity conditions where applicable and record static pressure at sensor(s).
      5) Set terminal unit minimum airflow capacities where applicable.
   i. Balance Low Velocity Ductwork:
      1) Take traverse and static pressure readings in main branch ducts and set balancing dampers for approximate correct distribution of air.
      2) Proportionately balance all branch ducts.
      3) Proportionately balance all outlets and inlets.
      4) Make smoke gun tests to check for drafts and make final settings for optimum comfort conditions in occupied space.
      5) Recheck supply air unit performance and make any necessary final adjustments. Include allowances for wet coil, dirty filters, and other normal operating conditions which may reduce air flow.
      6) Record final measurements as required.

C. TAB Procedures for Water Systems:
   1. Perform balance of Domestic Hot Water systems before system disinfection.
   2. Adjust and set all applicable balancing valves to achieve proper water distribution to all components of the hydronic heating and cooling systems.
   3. When valves are in final balance position, permanently mark by placing a punch mark or a scratch mark or by drilling a hole in body of valve and setting memory ring where applicable.
   4. Verify pump performance by means of system flow meter and/or pump head measurements in conjunction with shutoff head measurement.
   5. Remeasure pump delivery after system is proportionally balanced.
   6. Test and balance secondary pumping circuits as required by system type.
   7. Immediately after system balance, report pump throttling required to Engineer.

3.2 FIELD QUALITY CONTROL

A. Preliminary Review and Analysis:
   1. If after standard balancing procedures have been carried out and readjustments attempted, the system does not perform as specified, Engineer shall be notified at once.
   2. All "as is" field data shall be submitted in a preliminary report for review and analysis.
   3. Submit a preliminary report of Domestic Hot Water system balance as it is a prerequisite for system disinfection by others.
   4. Manipulation of system to achieve air flow and balance without meeting intended and specified total system air flow will not be accepted in a balance report. Should this occur, rebalance shall be at the Contractor's expense.

B. Final Inspection: Prior to final acceptance, all systems shall be operated to test performance as directed to the satisfaction of the Engineer:
   1. Water shall circulate throughout entire system without noise, evidence of leaks and trapping or air-binding.
   2. Air in ducts shall flow without excessive noise.
   3. Motors, fans and other equipment shall operate without excessive noise or vibration.
   4. Systems shall be balanced to operate within stated tolerances. If any heating unit, or air inlet/outlet does not operate within the stated tolerances, then the entire system shall be considered out of balance and shall be readjusted until all units are within the stated tolerances.
   5. Heating, ventilating and air-conditioning systems shall maintain uniform temperatures without drafts.
   6. Burners shall be tested and set for high efficiency and smokeless combustion.

C. Testing:
   1. TAB engineer shall coordinate with Commissioning Provider to schedule access to site to perform air and hydronic system testing to whatever extent Commissioning Authority determines is necessary to verify accuracy of mechanical systems TAB report.
   2. TAB engineer will repeat system testing, adjusting, and balancing until Commissioning Provider verifies accuracy of data.

3.3 STATIC PRESSURE AND AIR FLOW PROFILE

A. Provide a static pressure and air flow profile diagram similar to Exhibit A attached:
   1. Air flow readings shall be based on a duct traverse.
   2. Data shall reflect actual coincident system performance established at total system balance:
      a. Throttling of one branch below design to obtain design performance in another is not acceptable. Refer to Paragraph 3.2.A.
      b. Diversity in variable air volume systems shall be reflected on profile diagram.
   3. Provide data for each duct main and a minimum of one set of readings for each floor for multiple floor systems.

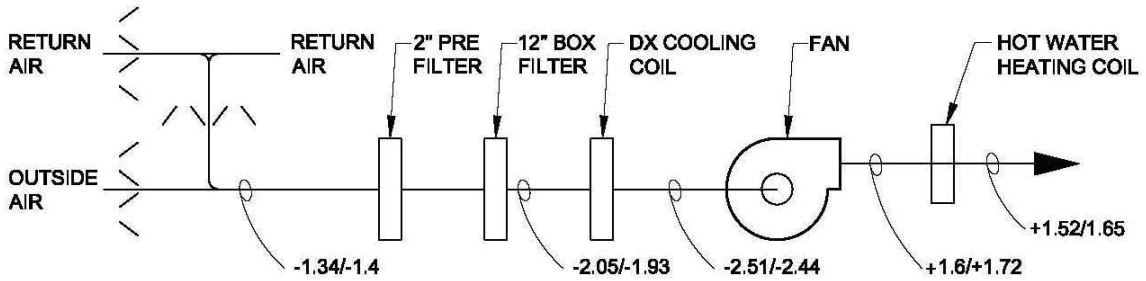
3.4 PRE TEST AND BALANCE CHECKLIST

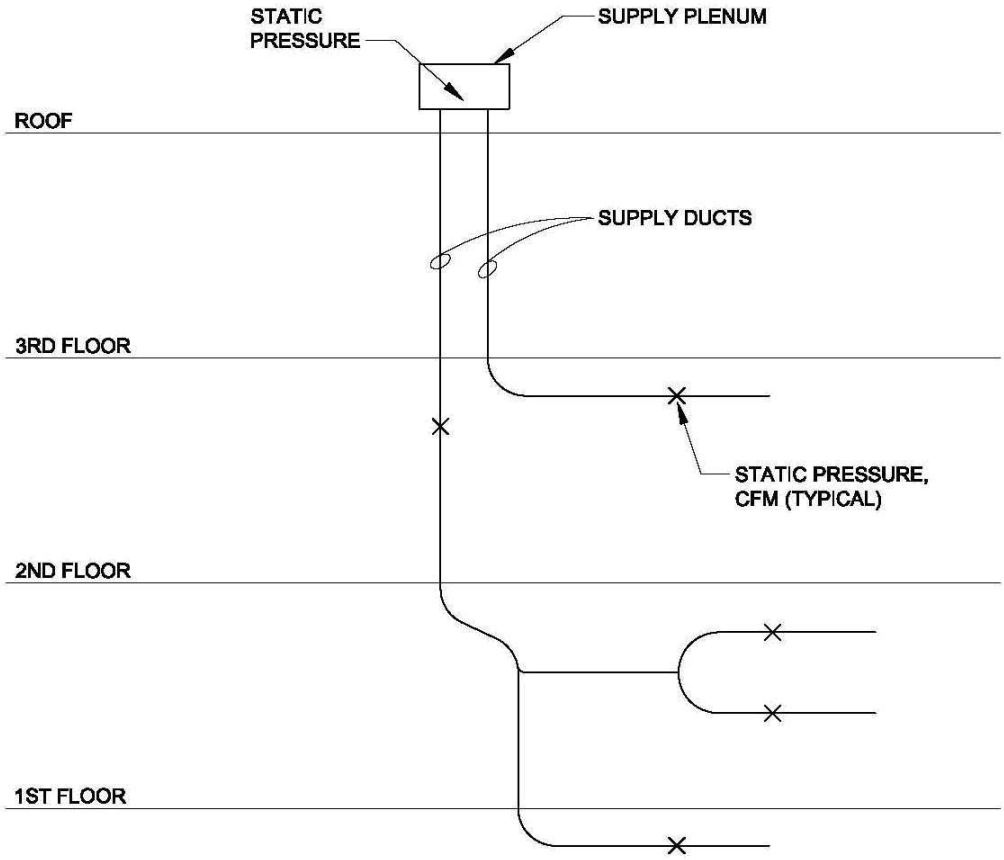
A. Contractor shall copy the following Pre Test and Balance Checklist (Exhibit B, attached) and submit one completed checklist for each AHU, pump, chiller, boiler, cooling tower, fan, cabinet heater, and unit heater.

B. TAB engineer may be entitled to be compensated for additional time required due to failure of other Subcontractors to properly complete their work.

SCHEMATIC AND NOTES:

STATIC PRESSURE AT MAXIMUM OUTSIDE AIR/MINIMUM OUTSIDE AIR





STATIC PRESSURE PROFILE AT FINAL BALANCED CONDITIONS
NO SCALE

EXHIBIT A

EXHIBIT B
PRE TEST AND BALANCE CHECKLIST

Equipment Tag No. _____ Date: _____

As an aid to properly interface work between trades and prevent unnecessary return visits for everyone concerned, the TAB engineer requires that the following list of items be completed by the Mechanical Subcontractor prior to any testing and balancing of air and hydronic systems.

Work required is as follows:

☑	Item No.	Description
	1.	Static pressure control sensors shall be installed in locations indicated on contract documents.
	2.	Variable frequency controllers installed on fan drives shall be properly set up for minimum to maximum speed positions.
	3.	Fan rotation is correct.
	4.	Fan RPM is to be set after fan performance test by Test and Balance Contractor, however, initial installed RPM shall be within 10 percent of what was intended per equipment submittal.
	5.	Verify that fan is running within motor nameplate amp draw at initial installed RPM.
	6.	Balancing dampers shall be installed in locations shown on Contract Documents.
	7.	Damper operators shall be installed with provisions for access and not covered with insulation.
	8.	All (normal operational) dampers shall be set and locked in the 100 percent open position.
	9.	All filters shall be in place, including clean construction filters installed upstream.
	10.	Terminal units shall be functioning with thermostat.
	11.	Terminal units shall be sequencing properly with radiation valve (i.e., normally closed T.U. with normally open valve, etc.).
	12.	Reverse acting (R.A.) thermostat shall be with N.O. terminal boxes and direct acting (D.A.) thermostat shall be with N.C. terminal boxes.
	13.	All air shall be bled from heating hot water system.
	14.	All (normal operational) valves shall be set in 100 percent open position
	15.	Memory devices shall be installed on all specified balancing valves
	16.	Installation of all temperature wells and gage cocks.
	17.	Pressure taps shall be installed across body of pump and inlet and outlet of coils. Location of pressure taps shall be between isolation and check valves, etc., associated with coils.
	18.	Hydronic systems shall have been cleaned and flushed and construction strainers removed from equipment.
	19.	Pump rotation shall be correct.
	20.	Verify that pump is running within motor nameplate amp draw at initial installed impeller size.
	21.	All exhaust fans shall be wired, operable and in correct rotation.
	22.	All multiple exhaust duct system balance dampers shall be installed and set 100 percent open.
	23.	All or backdraft dampers shall be set for proper operation, i.e., just closing.

END OF SECTION 23 05 93

SECTION 23 07 13 – DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of thermal insulation applied to external surfaces of ductwork and air handling devices. Internal acoustical duct liner is not included in the work of this Section. Coordinate this work with duct liner requirements in accordance with Division 23 Section “Sound and Vibration Control for HVAC.”

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Specifications:
      a. C411 – Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation.
      b. C553 – Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications.
      c. C612 – Mineral Fiber Block and Board Thermal Insulation.
      d. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
      e. E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
      f. E814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
      g. D1970 – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
   2. NFPA Standard:
      a. 90A – Installation of Air Conditioning and Ventilating Systems.
      b. 255 – Surface Burning Characteristics of Building Materials.
   3. SMACNA: MF-1 – Mechanical Fastener Standard.
   4. ASHRAE Standard: 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-rise Residential Buildings, with state amendments.
   5. Underwriter’s Laboratories:
      a. UL 1978 – Standard for Grease Ducts.
      b. UL-181 – Factory-Made Air Ducts and Air Connectors.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all thermal materials.
   1. Manufacturer product data brochure.
   2. Thermal performance characteristics – "K" Values.
   3. Details of construction and installation.
   4. Compliance with standards and UL listing.

B. Samples:
   1. Proposed substitutions for products other than those herein specified.
   2. Engineer's approval prior to installation.
   3. Fire barrier shall have the following ratings:
      a. Flame Spread Maximum: 0.
      b. Smoke Developed Maximum: 0.
      c. In accordance with ASTM E84.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Regulatory Agencies Requirements:
   1. State and local codes and ordinances.
   2. Insulation, facing and adhesive shall have a composite rating:
      a. 25 flame spread maximum.
      b. 50 smoke developed maximum.
      c. In accordance with NFPA 255.
   3. Fire barrier shall have the following ratings:
      a. 0 flame spread maximum.
      b. 0 smoke developed maximum.
      c. In accordance with ASTM E84.

1.6 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered in original, unbroken, brand marked containers.

B. Handle and store materials in a dry place in a manner which will prevent deterioration and contamination with foreign matter.

C. Reject damaged, deteriorated, contaminated material, or showing evidence of moisture, and immediately remove from the Site. Replace removed materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Thermal Insulation:
   1. Owens-Corning.
   2. Johns Manville.
   3. Armacell.
   4. Certainteed.
   5. Rubatex.
   6. Knauf.

B. Adhesives:
   1. Benjamin-Foster.
   2. Baldwin-Ehret-Hill.
   3. Childers.
   4. Foster.
   5. Armstrong.
   6. Goodloe &. Moore.

C. Waterproofing Membrane: MFM Building Products Corp.

2.2 MATERIALS

A. Rigid Fiberglass Board (R):
   1. Glass fibers bonded into rigid rectangular panels.
   2. Density: 6.0 lbs/cu ft.
   3. Thickness: As scheduled.
   4. Thermal Conductivity (k): 0.22 BTU-in/hr-SF – F degrees at 75 degrees mean.
   5. Facing: All service jacket (ASJ).
   6. Owens-Corning, #705; or equal.

B. Flexible Duct Wrap (F):
   1. Glass fiber blanket, factory-laminated to vapor barrier facing.
   2. Density: 0.75 lbs/cu ft.
   3. Thickness: As scheduled.
   4. Thermal Conductivity (k): 0.30 BTU-in/hr-SF – F degrees at 75 degrees mean.
   5. Facing: FSK.
   6. Owens-Corning, Type 75; or equal.

C. High Density Flexible Duct Wrap (F-HD):
   1. Glass fiber blanket, factory-laminated to vapor barrier facing.
   2. Density: 1.50 lbs/cu ft.
   3. Thickness: As scheduled.
   4. Thermal Conductivity (k): 0.25 BTU-in/hr-SF – F degrees at 75 degrees mean.
   5. Facing: FSK.
   6. Owens-Corning, Type 150; or equal.

2.3 COVERING

A. Self-Adhering Sheet Type Membrane (WPM):
   1. Embossed Aluminum Sheet: 45 Mils (1.0 mm).
   2. Multiple layers of high-density cross-linked polymer film.
   3. Layer of rubberized asphalt adhesive.
   4. Vapor Permeance (ASTM E 96): .01 perms.
   5. Nail Sealability (ASTM D 1970): Pass.
   6. Heat Aging (ASTM D 794): Pass.
   7. Elongation (ASTM D 412): 450 percent.
   8. Tear Resistance (ASTM D 1424): 660 grams.
   9. Exceeds 25/50 Flame/Smoke Rating (ASTM E 84).
   10. Maximum Temperature: 175 degrees F (79 degrees C).
   11. Installation Temperature Range: Greater than 40 degrees F (4.5 degrees C).
   12. Flex-Clad 400 as manufactured by MFM Building Products Corp.

2.4 MECHANICAL FASTENERS

A. Impale Anchor:
   1. 12-gage galvanized steel.
   2. With self-adhesive pad.
   3. 2-inch speed washer.

2.5 ADHESIVES

A. Insulation-Adhesive and Tape: As recommended by Manufacturer of insulation.

B. Canvas Adhesive: Foster 30-36, Childers CP-50 AMV-1; or approved equal.

C. Hot Service Mastic: Foster, #46-50, Childers CP=10/11; or approved equal.

D. Waterproofing Membrane Adhesive: MFM Spray Adhesive™ as manufactured by MFM Building Products Corp.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean ductwork surfaces prior to applying insulation.

3.2 INSTALLATION

A. Follow insulation Manufacturer's recommended procedures.

B. Thermal Insulation:
   1. Rigid insulation shall be attached with mechanical fasteners spaced no more than 16 inches center- to-center and no more than 3 inches from ductwork edges or insulation joints.
   2. Flexible wrap insulation shall be attached with 4-inch wide strips of insulation bonding adhesive spaced at 8 inches center-to-center. Adhesive shall be applied over entire surface of ductwork conveying or subjected to unconditioned outside air.
   3. Mechanical fasteners shall also be used on the underside of rectangular ductwork runs wider than 24 inches. Fastener spacing in accordance with A. above.
   4. Allow maximum fullness at corners when using flexible wrap.
   5. Provide removable section of insulation with a protected edge over access doors and around damper operators to allow operation without damage to insulation.

C. Waterproofing Membrane:
   1. Apply waterproofing membrane in accordance with Manufacturer's instructions at locations indicated on the Drawings. Do not use as a substitute for banding, pinning or other means of securely attaching insulation and underlying materials.
   2. Apply membrane to clean, dry, primed metal ductwork and foil-faced rigid insulation boards. Do not apply over wet or non-rigid insulation.
   3. Apply membrane in accordance with Manufacturer's air, material, and surface temperature requirements. Minimum application temperature is greater than 40 degrees F (4.5 degrees C).
   4. Apply firm, uniform pressure with hand roller to entire membrane to ensure proper adhesion. Concentrate pressure at seams and on underside of ductwork.
   5. Ductwork mounted outside must be pitched to shed water to prevent ponding water.
   6. Apply membrane shingle fashion to shed water over, not against, laps.
   7. Do not terminate membrane on bottom of duct.
   8. Apply minimum 3 inches (76 mm) side laps and minimum 6 inches (152 mm) end laps for ductwork applications.
   9. Embed membrane to bottom of ducts over 24 inches (610 mm) wide in light continuous layer of adhesive applied to insulation facer.
   10. Apply membrane to bottom of insulated ducts over 24 inches (610 mm) wide using mechanical attachment, in addition to adhesive, in accordance with Manufacturer's instructions. Install pins on 12 inches (305 mm) centers with rows staggered.
   11. Apply adhesive to areas where special adhesion requirements exist, including duct bottoms, flashings, transitions, joints, elbows, valves, tees, and other fittings.

D. Joints and Sealants:
   1. Joints shall be tightly butted and sealed with 3-inch (minimum) foil reinforced kraft tape. Fastener penetrations and any other punctures in the vapor barrier facing shall also be taped and sealed with vapor barrier adhesive. Seams, penetrations, and punctures shall also be vapor sealed with a 4-inch wide coating of vapor barrier mastic.
   2. Flexible wrap insulation joints shall be made with a 2-inch overlap of the vapor barrier secured with 9/16-inch outward clinching staples spaced 6 inches center-to-center.
   3. Taped joints at patches on rigid insulation shall be burnished or ironed on to ensure a tight seal.
   4. Use double tape strips when joining faced with unfaced insulation.

E. Damper Handles:
   1. Seal all exposed edges of insulation around handles.
   2. Tie a 2-foot long piece of bright orange ribbon on handle so it hangs down allowing easier visual locating of dampers.

3.3 APPLICATION SCHEDULE

A. Insulation Material Type:

R = Rigid fiberglass board
F = Flexible duct wrap
F-HD = High density flexible duct wrap
L = Internal liner – Refer to Division 23 Section “Sound and Vibration Control for HVAC” for requirements

B. Covering (Refer to Part 2, Paragraph 2.3, of this Specification Section):

CS = Exterior coating system
WPM = Waterproofing membrane

C. Flanged Ductwork: Insulation thickness indicated shall be increased to be at least a 1/2-inch thicker than the flange depth.

D. Coordination of Insulation:
1. Requirements for internal liner for sound control are in addition to other requirements above. However, thickness requirements for external insulation may be reduced by up to 1-1/2-inch when duct liner is used.
2. Refer to Division 23 Section “Sound and Vibration Control for HVAC” for acoustic duct liner requirements.

E. Definitions:
1. Concealed: A space concealed from view or otherwise accessible only through the removal of ceiling tiles, access panels, or building construction components.
2. Exposed: Not concealed.
3. Plenum: A ceiling plenum or other concealed space used to transport air.
4. Heated Space: A space with a direct supply of heating from HVAC system or equipment in space.
5. Warm Space: A space within the building thermal barrier and also within the building vapor barrier but not having a direct supply of heating.
6. Unheated Space: A space within the building but outside of either the building thermal barrier or the building vapor barrier.
7. Cooled Space: A space with a direct supply of cooling.
8. Outside Air and Mixed Air: Unconditioned outside air, partial outside air, or relief or exhaust air downstream of last damper and subjected to unconditioned outside air.

F. Duct Insulation Schedule:

DUCT INSULATION SCHEDULE – ASHRAE 90.1 2019							
Duct System	Internally Lined	Insulation Type	External Insulation	Double Wall Insulated	Cover	Not Insulated	Notes
SA Upstream of VAV Boxes in return air plenum	-	F	1.5"	Note 4	-	-	1
SA Downstream of VAV boxes in return air plenum	-	F	1.5"	-	-	-	1
SA and RA in unconditioned ceiling plenum (if RA is fully ducted)		F-HD	2”				2
RA in plenum	-	-	-	Note 4	-	Y	
Exhaust and Relief from control or backdraft damper to outside wall or roof	-	R	1.5"	-	-	-	2

DUCT INSULATION SCHEDULE – ASHRAE 90.1 2019							
Duct System	Internally Lined	Insulation Type	External Insulation	Double Wall Insulated	Cover	Not Insulated	Notes
Transfer Ducts	1"	L	-	-	-	-	
Exterior rectangular SA and RA	-	-		Note 4	WPM	-	3
Exhaust Air							
Notes:							
1. Minimum installed R-value = 4.2							
2. Minimum installed R-value = 6.0							
3. Minimum installed R-Value = 12.0							
4. Supply and Return ductwork within 20' of RTU shall be 2" double wall construction with no exterior insulation.							
5. Provide cover on ductwork below 8’-0” AFF.							

G. Internal Duct Liner:
   1. At Contractor’s option, with Engineer’s pre-approval, Contractor may substitute internal acoustic duct liner (Type L) for insulation listed at sufficient thickness to provide equivalent thermal insulating value.
   2. Where round or flat-oval ductwork is used, pre-insulated, perforated lined ductwork may be used in lieu of internal acoustic liner.
   3. Internal duct liner is not allowed in a duct conveying any amount of unconditioned or unfiltered air.
   4. Refer to Division 23 Section “Sound and Vibration Control for HVAC” for acoustic duct liner requirements and Division 23 Section “Metal Ducts” for round and flat oval pre-insulated, perforated lined ductwork.

END OF SECTION 23 07 13

SECTION 23 07 19 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of piping insulation.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Specifications:
      a. B209 – Aluminum and Aluminum Alloy Sheet and Plate.
      b. C533 – Calcium Silicate Block and Pipe Thermal Insulation.
      c. C534 – Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
      d. C547 – Mineral Fiber Preformed Pipe Insulation.
      e. C552 – Cellular Glass Block and Pipe Thermal Insulation.
   2. ASTM Standard Test Methods: E84 – Surface Burning Characteristics of Building Materials.
   3. National Fire Protection Association (NFPA) publications: NFPA 255 – Surface Burning Characteristics of Building Materials: 25, 50, 50 flame spread, fuel, smoke.
   4. ASHRAE:
      a. 90A – Energy Conservation in New Building Design, current edition.
      b. 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-rise Residential Buildings, with state amendments.

1.4 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable. Handle and store materials in a manner which will prevent deterioration and contamination with foreign matter.

B. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace removed materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Insulation:
   1. Pittsburgh-Corning.
   2. Owens-Corning.
   3. Certainteed.
   4. Armacell.
   5. Rubatex.
   6. Knauf.
   7. Johns Manville.

B. Jacketing (Aluminum or PVC):
   1. Ceel-Co.
   2. O'Brien.
   3. Zeston.
   4. Childers.
   5. Pabco.

C. Adhesives:
   1. Foster.
   2. Childers.
   3. Vimasco.
   4. B.E.H.
   5. Or approved equal.

2.2 TYPES OF INSULATION MATERIALS

A. Rigid Molded Glass Fiber – General (FG):
   1. All-service jacket (ASJ) type factory applied jacketing.
   2. 3.5 lbs/cu ft minimum density.
   3. k factor: See scheduled value listed in table herein.
   4. 850 degree F service temperature.
   5. Pipe 16-inches and Below: Owens-Corning Type SSL-II with ASJ Max; or equal
   6. Pipe Above 16-inches: Owens-Corning Large Diameter Type SSL with ASJ Max Pipe Insulation; or equal.

B. Flexible Elastomeric Thermal Pipe Insulation (E):
   1. Density of 5.0 lbs/cubic foot.
   2. k factor: See scheduled value listed in table herein.
   3. Maximum water vapor transmission of 0.17 per inch.
   4. Must be listed for 25/50 flame/smoke spread for thickness used.
   5. Armacell Armaflex AP; or equal.

C. Polyurethane insulation (PU) shall conform to one of the following:
   1. A continuously molded foam insulation having:
      a. Nominal density of 1.0 lbs/cubic foot.
      b. k factor: See scheduled value listed in table herein.
      c. Flame spread rating of 25 or less when tested in accordance with ASTM E84.
      d. Factory applied vapor barrier jacket.
   2. A continuously molded foam insulation having:
      a. 2 to 2.5 lbs/foot density.
      b. k factor: See scheduled value listed in table herein.
      c. Factory-applied vapor barrier jacket.

2.3 REUSABLE INSULATION SYSTEMS

A. For use at flanges and valves.

B. Manufacturer: Fit Tight Covers, Unitherm, Firwin.

C. Equal to Firwin Thermowrap.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install piping insulation:
   a. In conformance with the Drawings, these Specifications, and the Manufacturer's recommendations.
   b. Over clean, dry piping system.
   c. To the following thickness:
      1) As specified herein or as indicated on the Drawings.
      2) If not specified herein or indicated on the Drawings, in accordance with Manufacturer's recommendations for the specific application.
   d. Continuous through walls, ceilings and sleeves except at fire stops.
2. Fill all cracks and voids with insulating cement carefully troweled to leave a smooth finish.
3. Repair or replace insulation damaged by:
   a. Demolition.
   b. Making connections to piping or equipment.
   c. Water or mildew.
4. Insulate bundles of pipes out-of-doors with complete wrap of insulation 1-1/2 inches thick and of suitable diameter to contain bundle, with outer wrap.
5. Verify that piping has been tested and cycled before applying insulation materials.
6. All sectional pipe covering shall be neatly and tightly applied with unbroken lengths and with the ends of the sections firmly butted together. Longitudinal joints shall be on the least conspicuous side of the pipe and slightly staggered. Fiberglass cloth or other coating shall be lapped over all joints and well pasted or cemented down in a neat and inconspicuous manner.
7. The insulation on piping shall be extended through all sleeves, anchor points and supports in order to produce a continuous application, and same shall be installed to conform to a uniform diameter.
8. All fittings, flanges, end caps, etc. on all lines, except where otherwise noted, shall be covered with insulated fitting covers. Thickness of insulation, jackets and finishes shall also match adjacent piping.
9. Insulation for piping shall be continuous through hangers and supports.
10. Provide insulation inserts and insulation protection shields at hanger or support locations.
    Valve bodies to the bonnet flange or union, drip legs, and pipes at anchor points shall be insulated. Terminate insulation into a finished end.
11. Terminate insulation into a finished end.

B. Joints and Fittings:
1. Block insulate valves and flanges with reusable insulation system.
2. Insulate elbows, tube turns, sweeps and bends with mitered sections or premolded fittings. Match pipe covering material where used.
3. Fit joints tightly together.
4. Seal joints with sealing compound and preformed aluminum bands.

3.2 JACKETS AND FINISH

A. General:
1. Provide moisture barrier between the insulation and the jacketing in a continuous, unbroken seal.
2. Hold jacketing in place by a continuous sealed joint, providing a positive weatherproof seal along the entire length of the jacket.
3. Cap off ends with caps.
4. On cold lines, cut caps to the exact size of the pipe and seal with a recommended silicone calking.
5. Provide slip joints a minimum of every 25 feet or as needed for expansion.
6. Locate longitudinal jacket seams on indoor exposed piping out of view.

B. PVC:
1. Center a preformed strap (snap-strap) containing a permanently weatherproof plastic sealant over each circumferential joint and secure by tightening on a clip, or by use of a separate stainless steel banding.
2. Design snap-strap to take care of normal expansion.
3. Cover all pipe insulation and preformed insulation fittings.

4. Weld longitudinal seams together with welding adhesive as supplied by cover Manufacturer.
5. Overlap adjacent jacketing 3/4-inch and weld circumferential seams together with welding adhesive.
6. Overlap fitting covers to adjacent pipe insulation jacketing. Weld longitudinal and circumferential seams together with adhesive.

C. Attachment:
1. For systems operating below 50 degrees F: Vapor seal laps using self-sealing lap, lap seal tape gun or adhesive such as Benjamin Foster 520.

D. Taper and seal insulation ends regardless of service.

E. Fitting and pipe jackets to have matching finishes ready for painting.

3.3 PIPING INSULATION APPLICATION SCHEDULE

A. Basis of Thickness Chart:
1. Thicknesses shown are based on products having a maximum "k" factor at the mean temperature listed in table herein .
2. These Thicknesses:
a. Can be reduced for products having significantly lower "k" values.
b. Shall be increased for products having higher "k" values in order to produce equivalent or greater thermal resistance.
c. Changes in thicknesses shall be in accordance with ASHRAE 90.1.

B. Flame/Smoke Ratings: Local requirements for flame and smoke ratings must be met and may exclude some options listed herein.

C. Jackets and Finish Application:
1. Provide aluminum jacket on insulated piping located outside.

D. Thickness Chart (In Inches):
1. Key: Insulation Type (Refer to Paragraph 2.2 of this Section):
a. FG = Rigid Fiberglass.
b. E = Flexible Elastomeric.
c. PU = Polyurethane.

					PIPE SIZE					
	Piping Systems Type	Temp (F) Range	Thermal Conductivity k (BTU·in / hr·ft·F degrees)	Mean Rating Temp (F)	Less Than 1″	1″ to <1-1/2″	1-1/2″ To <4″	4″ to <8″	8″ & Up	Type of Insulation *
1.	Heating Water	105-140	0.22 – 0.28	100	1.0	1.0	1.5	1.5	1.5	FG
2.	Refrig/Brine	Below 40	0.20 – 0.26	50	0.5	1.0	1.0	1.0	1.5	E
3.	Refrig Suction	40-60	021 – 027	75	0.5	0.5	1.0	1.0	1.0	E
4.	Cooling Coil Drain	--			0.5	0.5	0.5	1.0	--	FG, E

* See PART 2 – PRODUCTS Article 2.2 TYPES for types of insulation.

END OF SECTION 23 07 19

SECTION 23 08 00 – COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the Owner's operational needs.

B. Commissioning during the construction phase is intended to achieve the following specific objectives:
   1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
   2. Verify and document proper performance of equipment and systems.

C. Commissioning does not relieve the Contractor of responsibility for providing complete and fully functional systems in accordance with the Contract Documents.

1.3 SUMMARY

A. This Section identifies the mechanical systems to be commissioned and establishes the commissioning process and responsibilities of the parties involved.

1.4 SYSTEMS TO BE COMMISSIONED

A. The following systems will be commissioned:
   1. Rooftop Units: ductwork, VAV boxes, controls.
   2. Heating Water Systems:
      a. Pumps.
      b. Piping.
      c. Boilers.
      d. Radiant-Convective Wall Panels
      e. In-floor Trench Heaters
      f. Coils.
   3. Exhaust Systems: Fans, ductwork, controls.
   4. Split Systems:
      a. Indoor Units.
      b. Outdoor units.
      c. Piping.
   5. Building Automation System:
      a. Operator interface functions and graphics.
      b. Actuators.
      c. Controls sensors.
      d. Control valves and dampers.
      e. Alarms.
   6. Fan Coil Units: ductwork, controls.

1.5 ABBREVIATIONS

A. The following are common abbreviations used in the Commissioning Specifications.

A/E	Architect and Design Engineers	Subs	Subcontractors
CC	Controls Contractor	MC	Mechanical Contractor
Cx	Commissioning	MEP	Mechanical, Electrical, Plumbing Systems
Cx Plan	Commissioning Plan	TAB Sub	Test, Adjust and Balance Contractor
FT	Functional Test		

1.6 COORDINATION

A. Commissioning Team: The members of the commissioning team consist of the Commissioning Provider (CxP), the Owner, the Owner's Facility Manager, the designated commissioning representative of the Contractor, the architect and design engineers of record (A/E) (particularly the mechanical engineer), the Mechanical Contractor (MC), the Test, Adjust, Balance Contractor (TAB Sub), the Controls Contractor (CC), and other installing subcontractors or suppliers of equipment.

B. Scheduling. The CxP will work with the Contractor according to established protocols to schedule the commissioning activities.

1.7 COMMISSIONING PROCESS

A. Development of Functional Tests:
   1. The CxP develops functional test procedures which are reviewed by commissioning team members.
   2. CxP incorporates comments as appropriate.

B. Review of Specified Test Reports:
   1. The CxP reviews test results and provides comment to the Contractor.
   2. Items of non-compliance are corrected at the Contractor's expense and revised test results submitted for review.

C. Execution of Functional Tests:
   1. The Contractor shall conduct “systems readiness testing” of functional test steps on their own before functional test demonstrations with the CxP present.
   2. Items of non-compliance in material, installation, and operation are corrected and the system retested at the Contractor’s expense.
      a. Failed functional test steps requiring additional site visits by the CxP because of incomplete work, improper installation, programming deficiencies, or other Contractor-caused deficiencies shall result in a charge of $1,500 per CxP day on site. These charges are to be reimbursed to the CxP.

D. Commissioning activities required by applicable energy codes shall be incorporated into the commissioning process described in this Section.

1.8 RESPONSIBILITIES

A. All Parties:
   1. Follow the Cx Plan.
   2. Attend commissioning kick off meeting and additional meetings, as necessary.
   3. Properly schedule, log, and discharge commissioning activities and responsibilities throughout this project.

B. A/E:
   1. Construction and Acceptance Phase:
      a. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual review, etc., as contracted.
      b. Provide latest documentation of design narrative documentation requested by the CxP.
      c. Respond to RFIs generated through the commissioning process.

d. Review and approve the O&M manuals.
e. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings, or equipment documents are not sufficient for writing detailed testing procedures.

C. Commissioning Provider (CxP): The primary role of the CxP is to develop and coordinate the execution of a testing plan (commissioning plan), observe and document installation and performance – that systems are installed and functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied by the CxP
1. Construction and Acceptance Phase:
a. Develops and publishes a commissioning plan to aid in coordination and direction of the commissioning activities.
b. Conduct commissioning meetings on site with the commissioning team.
c. Write and distribute functional test procedures.
d. Perform site visits to observe component and system installations
e. Approve test reports, controls checkout reports, TAB documentation, etc.
f. Analyze trend logs and monitoring data to verify performance.
g. Coordinate, witness and approve functional tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.
h. Maintain an Issues Log and a separate testing record. Provide the Contractor with written reports with recommended actions.
i. Sign-off (final approval) on individual commissioning tests as completed and passing. Recommend completion of the commissioning process to the Owner.
j. Compile and maintain a commissioning record.
k. Provide a final commissioning report.

D. General Contractor / Construction Manager (Contractor):
1. Construction and Acceptance Phase:
a. Assign a single person to manage the commissioning activities on behalf of the Contractor and serve as a single point of contact and communication for the Contactor in all commissioning activities.
b. Include commissioning activities in the master construction schedule and ensure subcontractor participation and responsiveness in the commissioning process. All subcontractors are to provide work related to their disciplines to support the Cx work being performed by the CxP. The following subcontractor work items are emphasized
1) Controls Contractor (CC)
a) In a timely manner, review and comment on feasibility of functional test (FT) steps as developed by CxP.
b) Operate all control devices to support Cx work:
(1) Operate each control sequence individually and in combination with related control sequences for a sufficient duration to demonstrate compliance with the performance requirements of the Contract Documents.
(2) Demonstrate through functional testing that each Sequence of Operation performs as specified and maintains design operating conditions. The Controls Contractor shall assist the CxP in developing functional testing procedures.
c) Provide:
(1) As-built sequences of operation including all setpoints
(2) Sensor calibration records
(3) Trending – configure, collect, and provide trend data and trend logs requested by the CxP to support verification of system performance.
(4) Final controls system setpoint schedule.
2) Test, Adjust, and Balance Contractor:
a) Submit TAB reports for review.
b) Participate in commissioning activities when requested by the CxP.
c) Rebalance systems as required to resolve deficiencies identified during commissioning.
d) Attend commissioning meetings as requested.
c. Enforce on-time submittal of commissioning documentation by subcontractors.

d. Attend commissioning team meetings to facilitate the commissioning process.
e. Perform the normal review of Contractor submittals.
f. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxP.
g. When necessary, observe and witness start-up and functional testing of selected equipment.
h. Furnish CxP a copy of specification-required construction test reports, e.g., pipe cleaning, pipe flushing, pipe leak tests.
i. Review commissioning progress and Issues Logs.
j. Coordinate the resolution of deficiencies identified in all phases of commissioning.
k. Include the cost of commissioning in the total contract price.
l. In each purchase order or subcontract written, include requirements for submittal data, O&M data, and commissioning tasks.
m. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

2. Warranty Period:
   a. Ensure that Subs execute seasonal or deferred functional performance testing, witnessed by the CxP, according to the Specifications.
   b. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
   c. Participate in 10-month warranty review meeting.

E. Owner:
1. Construction and Acceptance Phase:
   a. For any owner-provided testing, enforce submission of specified test reports to Contractor and CxP for systems being commissioned.
   b. Provide final approval for the completion of the commissioning work.

F. Equipment Suppliers:
1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
2. Assist in equipment testing as specified in agreements with Subs.
3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for:
   a. Stand-alone data logging equipment that may be used by the CxP.
4. Provide information requested by CxP regarding equipment sequence of operation and testing procedures.
5. Review test procedures for equipment installed by factory representatives.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform start-up and initial checkout and required functional testing shall be provided by the contractor for the equipment being tested.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment shall be included in the base bid price, and left on site, except for stand-alone data logging equipment that may be used by the CxP.

C. Portable data logging equipment and associated software required to test equipment will be provided by the CxP but shall not become the property of the Owner.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the Owner's design intent documentation. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have resolution of 0.1 degrees F and calibration within 6 months of use to an accuracy of ±0.5 degrees F. Pressure sensors shall have been calibrated within 6 months of use to an accuracy of ±3.0% of the value being measured (not full range of device)
   1. All calibration shall be to NIST traceable standards. (National Institute of Standards and Technology – www.nist.gov, 301-975-6478).
   2. All equipment shall be calibrated according to the manufacturer's recommended intervals and immediately after being dropped or damaged.
   3. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

Not used.

END OF SECTION 23 08 00

SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the design, furnishing and installation of HVAC instrumentation and controls (HI&C) systems:
   1. Basis of Design: Siemens Desigo Building Automation System, including Siemens Desigo CC management software, Desigo PXC automation controllers, Desigo DXR room automation controllers, Desigo TX-I/O modules, and Siemens connected field devices where indicated.
   2. Provide a unified Siemens Desigo architecture from field devices and room automation through primary automation, building management, and authorized cloud applications. Components shall use coordinated Siemens engineering, commissioning, graphics, alarming, trend, scheduling, cybersecurity, and lifecycle-management workflows.
   3. The Work of this Section also includes the integration of the Work of other trades as necessary to provide a complete operational control system as defined in the Contract Documents.

B. Major items unique to the work of this Section:
   1. Direct digital control (DDC) hardware.
   2. DDC software.
   3. All remote sensing devices and interconnecting wiring or tubing.
   4. All secondary control devices including, but not necessarily limited to, the following:
      a. Thermostats and humidistats.
      b. Temperature and humidity sensors.
      c. Primary and secondary controllers.
      d. Automatic valves and dampers.
      e. Damper and valve operators.
      f. Relays.
      g. Control panels.
      h. Operator interface.
      i. Network devices.
      j. Miscellaneous sensors.
      k. Weather stations.
   5. Electric power supply source.
   6. Conductor and conduit.
   7. Necessary appurtenances to make a complete and functional system to satisfy the functional intent.
   8. Final and complete operational demonstration.
   9. Mechanical testing, adjusting and balancing.

C. Mechanical systems included in the Work of this Section:
   1. Except as specifically described below, it is the work of this Section to provide, install and integrate complete control of the HVAC systems, including, but not limited to the following:
      a. Primary heating controls except:
         1) Boiler burner and safety controls.
         2) Boiler sequencer.
      b. Rooftop unit controls.
      c. Terminal unit controls.
      d. Ventilation system controls.
      e. Computer room air conditioning systems.

D. Integration:
   1. Provide communication interface and network integration for the following packaged control systems furnished under the Work of other Sections:
      a. Boiler burner and safety controls as specified in Division 23 Section “Condensing Boilers.”
      b. Boiler sequences as specified in the Drawings.
      c. Package rooftop units as specified in the Drawings.
      d. Variable air volume boxes as specified in Division 23 Section “Air Terminal Units.”

1.3 DIVISION OF WORK

A. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.

B. The following are suggestions as to how the Work may be divided. This is not intended to be a complete list of all the Work:
   1. Mechanical Subcontractor:
      a. Install automatic valves and separable wells that are specified to be supplied by HI&C Subcontractor.
      b. Provide all necessary valved pressure taps, steam, water drain and overflow connections and piping.
      c. Provide all necessary piping connections required for flow devices, valve position indicators, flow switches, etc.
      d. Install all automatic dampers unless furnished as a factory mounted item with HVAC equipment.
      e. Provide all necessary blank-off plates (safing) required to install dampers that are smaller than duct size.
      f. Assemble multiple section dampers with the required interconnecting linkages and extend required number of shafts through ductwork for external mounting of damper motors.
      g. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and seal permanently in place only after all stratification problems have been eliminated.
      h. Provide access doors or other approved means of access through ducts for service to control equipment.
   2. Electrical Subcontractor:
      a. Provide conduit, conductors, and wire for all 120 volt or higher devices which interlock equipment provided under Division 23 with equipment and devices provided under other Divisions of the Specifications as indicated on Electrical Drawings and Division 26 Specifications.
      b. Provide power to DDC panels as indicated on the Drawings.
      c. Provide devices, conduit and wiring as indicated on Electrical Drawings.
   3. HI&C Subcontractor:
      a. Be responsible for controls systems operation in accordance with sequence of operations description defined in Division 23 Section “Sequences of Operation for HVAC.”
      b. Furnish all automatic dampers, valves, operators and linkages.
      c. Provide a detailed schedule for the Mechanical Subcontractor of all automatic dampers and valves requiring their assembly or installation as suggested above.
      d. Provide 120 volt and low voltage power to all valve/damper motors requiring same.
      e. Wire all 120 volt flow, pressure and temperature sensing devices.
      f. Coordinate with Electrical Subcontractor for smoke detector interface compatibility and functional intent.
      g. Make final terminations to controlled components, including terminations from smoke detectors.
      h. Provide conductors and conduit, including low voltage and 120 volt, as required to provide functional intent, except as specifically indicated otherwise on Drawings or in the specifications.
      i. Provide all interface devices necessary for required communication to other systems.
      j. Provide for power supply for all DDC panels that are required that are in addition to those indicated on the Drawings.
      k. Operate all temperature control devices to confirm sequence of operations. Support Commissioning Authority in functional performance testing in accordance with the requirements of Division 23 Section “Commissioning of HVAC.”
      l. Provide certification to Commissioning Authority of complete control system function and calibration.
   4. Commissioning Authority (CxA): Provide verification of system function in conformance with design intent, including selected sensor calibration.

1.4 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with the following:
   1. ANSI – American National Standards Institute:
      a. ANSI/ISA S5.1 – 1984 – Instrumentation Symbols and Identification (Joint Standard with ISA – Instrument Society of America).
      b. ANSI X3.4 (ASCII).
      c. ANSI/ASHRAE Standard 135 – BACNet.
      d. ANSI/ASHRAE Standard 135 – BACnet, including applicable requirements for BACnet/IP and BACnet Secure Connect (BACnet/SC).
      e. ASHRAE Guideline 36 – High-Performance Sequences of Operation for HVAC Systems.
      f. ISA/IEC 62443 Series – Security for Industrial Automation and Control Systems.
      g. NIST Special Publication 800-82 – Guide to Operational Technology Security, where required by Owner.
      h. UL 508A – Industrial Control Panels, where applicable.
      i. UL 916 – Energy Management Equipment.
      j. ANSI/EIA Standard 709 – Control Network Protocol Specification (LONWorks).
   2. EIA – Electronic Industry Association: EIA Standard RS-232-C.
   3. NFPA – National Fire Protection Association:
      a. 70 – National Electrical Code.
      b. 90A – Standard for the Installation of Air-Conditioning and Ventilation Systems.

1.5 DEFINITIONS

A. Where applicable, the terminology used herein uses the definitions listed in ASHRAE Standard 13.

B. Other definitions used include:
   1. Low Voltage:
      a. Voltage less than 120V single phase, typically 24V AC.
      b. Low voltage is used primarily for communication and control of devices.
   2. Large Valves: Valves for piping greater than 2 inches in diameter.
   3. Large Dampers: Greater than 133-inch/pound torque required or 30 square feet.
   4. DDC: Direct digital controls.
   5. IP: Internet protocol.
   6. LAN: Local area network.
   7. HVAC: Heating, ventilating and air conditioning systems. Generally, the work of Division 23.
   8. Primary Controller: A device that includes IP to field bus router, automatic time scheduling, trend logging, alarm handling, and supervisory logic control functionality. Sometimes referred to as a Building Controller.
   9. Secondary Controller:
      a. Advanced Application Controller: A controller with provisions and the control logic for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air-handling unit, chiller or boiler. An Advanced Application Controller may or may not have data management features such as time schedules, trend data storage and alarm message generation capabilities. These features may be provided by the Building Controller.
      b. Application Specific Device or Controller: A sensor, controller, or end device that is pre-programmed by the vendor. It may have physical inputs and physical outputs. The control logic, while not programmable, may be configurable through the use of configuration parameters. The application may require input network variables and may send output network variables onto the network.
   10. Control Logic Diagram: A graphical representation of control logic for the multiple processes that make up a system. Logic symbols are used to represent:
      a. Input/Output (I/O) data.
      b. Control functions such as PID, two-position control, switches, etc.
      c. Math functions such as addition, subtraction, multiplication, division, etc.
      d. Boolean functions such as greater than, less than, equal to, etc.
      e. Limit functions such as maximum, minimum, ramps, etc.

11. Enterprise Level Data Manager (ELDM): A logic only device (controller without I/O) that is installed on the building LAN as the first node beneath the IP router. This device shall be programmable and be from the same Manufacturer that provides the enterprise level server and operator workstation software. The enterprise level data manager may be multiple identical devices installed on the building LAN in series in order to have sufficient capacity to support the building level controls. The enterprise level data manager may be combined in a single device with the IP router. The enterprise data manager serves 3 functions:
    a. Time Schedules: Time schedule algorithms shall reside in the enterprise level data manager. Occupancy/energize commands shall be broadcast to the building level controllers in the number required by the sequence of control.
    b. Trend Data Storage: The enterprise level data manager shall collect data from the building level controls at specified intervals and store the data for periodic uploading to the server. Polling communication techniques are acceptable for data collection by the data manager.
    c. Alarm Generation: The enterprise level data manager shall receive binary alarm variables from the building level controllers and transmit this data to the alarm handling software module within the server and operator work stations. Receipt of alarm data from the building level controls shall be based on broadcasting from the building level controls and not based on polling by the enterprise level data manager.
12. JACE: Java Control Engine. A term used within the Niagara Framework to describe a enterprise level data manager:
13. Managed Communication: The transmission of data from a controller to a data manager, which in turn rebroadcasts the data to a second controller. The data manager may be referred to a network controller
14. Peer to Peer Communication: Data is broadcast from its origin and is received by the final device requiring the data without being received and retransmitted by a third device.
15. Standalone Controller: A standalone controller has provisions for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air handling unit, chiller or boiler. The controller shall also have embedded in it all of the control logic that associated the physical inputs to the physical outputs. A standalone controller will also have data management features such as time schedules, trend data storage and alarm message generation capabilities.
16. TCP/IP: Transmission Control Protocol/Internet Protocol. A basic communications protocol in a private network, either an intranet or an extranet.
17. Web Server: A software package installed on a primary/secondary controller or ELDM that provides for operation access to the Enterprise Level system from a computer on the LAN, using only a browser.

1.6 DESIGN AND PERFORMANCE REQUIREMENTS

A. System layout and design responsibility are included as Work of this Section:
    1. **Siemens Desigo System Architecture:**
        a. Provide Siemens Desigo PXC4, PXC5, and PXC7 freely programmable automation controllers as appropriate to project size, I/O count, integration scope, and sequence complexity. Provide Siemens Desigo DXR room automation controllers for terminal and room applications and Siemens TX-I/O modules for distributed input and output expansion.
        b. Provide native BACnet communications throughout the Siemens control architecture. BACnet/IP and BACnet Secure Connect shall be used where indicated. Controllers shall continue assigned control, scheduling, alarming, trending, and energy-management functions during loss of communication with the management platform.
        c. Engineer and commission Siemens Desigo PXC and DXR applications using Siemens ABT Site. Use consistent application libraries, naming conventions, block programming, parameterization, and commissioning workflows across primary and room automation.
        d. Provide Siemens Desigo Assist where included with the furnished engineering release to support in-tool guidance for configuration, engineering, and troubleshooting. Provide Siemens Smart Building Recorder where included in the project scope to execute repeatable, documented, system-wide commissioning and validation tests.
        e. Provide the Siemens Desigo Room Automation Extension workflow to automatically generate applicable Desigo CC plant and room graphics from engineered automation data. Generated graphics shall remain editable and shall comply with project graphic standards.
        f. Where existing Siemens APOGEE or TALON infrastructure is identified, provide Siemens-supported Desigo modernization and compatibility methods that preserve approved existing investments while establishing a migration path to the current Desigo architecture.

2. **Siemens Product Cybersecurity:**
   a. The Siemens Desigo CC provider organization shall maintain secure development processes certified to ISA/IEC 62443-4-1 Maturity Level 3 or higher. The furnished Desigo CC building management system shall be certified to ISA/IEC 62443-4-2 Security Level 2 or higher.
   b. Provide current Siemens cybersecurity hardening guidance for Desigo CC, PXC, DXR, engineering tools, databases, interfaces, and connected services. Configure the system in accordance with the guidance and document project-specific exceptions.
   c. Provide Desigo CC BACnet/SC certificate handling, certificate-expiration notification, dual BACnet/IP and BACnet/SC network deployment, and interoperability with BACnet/SC devices by other vendors where such devices are specifically approved for integration.
3. General:
   a. Design, configure, document, and commission the BAS in accordance with Owner information technology and operational technology security requirements.
   b. Coordinate cybersecurity requirements with Owner information technology representative before assigning addresses, connecting devices, installing software, or connecting the BAS to an Owner-managed network.
   c. Cybersecurity requirements apply to servers, workstations, controllers, routers, gateways, network appliances, remote-access services, databases, web services, mobile interfaces, and third-party integrations furnished under this Section.
   d. Do not activate Internet-based, cloud-based, wireless, cellular, or remote-access connections without written authorization from Owner.
4. Secure Product Development:
   a. BAS platform Manufacturer shall maintain a documented secure product-development lifecycle. Upon request, submit evidence of independent certification to ISA/IEC 62443-4-1 or another Owner-approved industrial cybersecurity standard.
   b. Manufacturer shall publish cybersecurity advisories, security updates, and procedures for reporting suspected vulnerabilities.
5. Authentication:
   a. Integrate BAS authentication with an Owner-approved directory service where required. Where centralized authentication is not available, use individual local accounts. Shared accounts are prohibited unless specifically authorized by Owner.
   b. Change or disable default credentials before connecting equipment to Owner network. Submit administrative credentials using an Owner-approved secure method.
6. Certificate Management:
   a. For certificate-based communications, provide tools and documentation necessary to generate, install, renew, revoke, import, export, and replace certificates.
   b. Support certificates issued by Owner certificate authority or another Owner-approved certificate authority. Provide certificate-expiration monitoring and notification.
   c. Provide certificate-management software, configuration databases, trust-store information, and administrative documentation necessary for Owner to maintain the system.
7. System Hardening and Updates:
   a. Configure BAS in accordance with Manufacturer current cybersecurity hardening guidance. Disable unused accounts, services, protocols, ports, interfaces, and software components. Document exceptions and submit them for Owner approval.
   b. Identify installed software, firmware, operating-system, database, and third-party component versions. Before final acceptance, provide Manufacturer-supported security updates applicable to furnished products.
8. Details of construction, quantities, components and accessories indicated on the Drawings and in the Specifications are minimum requirements.
9. Increases in system component requirements beyond these minimums that are determined by the system designer to be necessary to provide the functional intent and for a complete system shall not be a basis for an increase in cost to Owner. Refer to the Drawings for sequence of operations.

B. Comply with the following performance requirements:
   1. Graphic Display: Display graphic with minimum 20 dynamic points or as required to display required data.
   2. Graphic Refresh: Update graphic with display with current data within 8 seconds.
   3. Object Command: Reaction time of less than 2 seconds between operator command of a binary object and device reaction.
   4. Object Scan: Transmit change of state and change of analog values to control units or workstation within 6 seconds.

5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within 5 seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as 5 seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC/PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
   a. Water Temperature: ±1 degree F (0.5 degree C).
   b. Water Flow: ±5% of full scale.
   c. Water Pressure: ±2% of full scale.
   d. Space Temperature: ±1 degree F (0.5 degree C).
   e. Ducted Air Temperature: ±1 degree F (0.5 degree C).
   f. Outside Air Temperature: ±2 degree F (1.0 degree C).
   g. Dew Point Temperature: ±3 degree F.
   h. Temperature Differential: ±0.25 degree F (0.15 degree C).
   i. Relative Humidity: ±5%.
   j. Airflow (Terminal): ±10% of full scale.
   k. Air Pressure (Ducts): ±0.1-inch wg (25 Pa).
   l. Carbon Dioxide: ±100 ppm.
   m. Electrical: ±5% of reading.

1.7 SUBMITTALS

A. Submit the following in accordance with Division 01 Section “Submittal Procedures.”

B. High-performance Control Sequences:
1. Except where modified by project-specific sequences, implement applicable HVAC control sequences in accordance with ASHRAE Guideline 36. Project-specific sequences in the Contract Documents take precedence.
2. Identify deviations between project sequences and applicable ASHRAE Guideline 36 sequences in the control submittal. Do not revise a sequence without written direction from Engineer.
3. Factory-programmed, configurable, or library-based sequences are acceptable only where they perform the complete specified sequence; permit adjustment of specified parameters; expose required values, alarms, modes, and overrides; include descriptive documentation; and can be tested through each required mode.
4. Control logic shall include applicable occupied and unoccupied operation, warm-up and cooldown, optimum start and stop, demand-controlled ventilation, economizer operation, supply-air-temperature reset, pressure reset, plant staging, alarm suppression, equipment-protection limits, sensor-failure response, communication-failure response, anti-short-cycle protection, and demand-based setpoint reset.
5. User-adjustable parameters shall be accessible to authorized users without modification of compiled programs. Calculated values needed to verify operation shall be visible at the operator interface.
6. Provide trend data sufficient to verify each sequence, including applicable setpoints, process variables, operating modes, equipment status, command values, and controller outputs.

C. Bid Submittals:
1. A description of the proposed system, including a schematic diagram showing system architecture and all major components. Indicate all controllers and devices at the LAN layer.
2. Original Manufacturer's literature for each type of controller, processor and input/output device that is shown on the schematic diagram.
3. Written verification that specified sequences of operation can be followed and performance requirements met, or a written list of variances required.
4. Written verification that all accessibility and interoperability requirements will be met, or a written list of variances required.
5. A specific description of proposed hardware and software expansion capabilities beyond the requirements described herein.
6. A sample logic schematic for at least 1 system similar to one used in this project.

7. The Bidder may, at Engineer's option, be required to make a personal presentation of the proposed system to Owner and Engineer prior to award.
8. Installer's Qualifications: Include certifications, experience of similar projects and other evidence of qualifications for this Work.

D. Submittals Prior to Construction:
1. A description of the complete system, including a schematic diagram showing system architecture and all major components, cabinets, panels, sensors, controllers, hubs and operated devices, and required cabling between each.
   a. Include any environmental and space requirements for equipment.
   b. Anticipated deviations from performance and response time specified.
   c. A layout drawing indicating locations of controllers and major devices.
2. Front-End Hardware and Software:
   a. Dimensions and installation requirements.
   b. Equipment and material specification data.
   c. Function/identification labeling.
   d. Clearly mark (in ink) all preprinted information.
3. Sensors, Controllers, Actuators and Related Devices:
   a. Complete system wiring diagrams and/or piping schematic including motor starters.
   b. Specification sheets on all individual control system components, including rated accuracy of sensors.
   c. Schedule of valves and dampers including size and performance characteristics.
4. Complete Descriptions of Operation:
   a. Written sequences for software and hard-wired controls.
   b. A sequence of control for each system being controlled. Include the following as a minimum.
      1) Process control sequence for each end device.
      2) Supervisory logic sequence of control for each system.
      3) The impact of each global application program on the sequence of control (Example: Demand Control).
      4) A list of all physical inputs and outputs associated with each sequence.
      5) Within the sequence of control, all application parameters that are to be user adjustable from an operator work station (OWS) shall be annotated with (adj) after the name of the parameter. This shall include setpoints, reset schedule parameters, calibration offsets, timer settings, control loop parameters such as gain, integral time constant, sample rates, differentials, etc.
      6) Within the sequence of control, all calculated values that are to be viewable at the OWS shall be annotated with (rpt) after the name.
      7) All points that shall be subject to manual control from an operator workstation.
      8) A list of all alarm points, a description of the alarm and a description of the alarm criteria.
      9) A list of all variables for which historical trending will be applied, the sample rates and any criteria used to start and stop the historical trending.
5. Wiring diagrams.
6. System Schematics: Include systems furnished by others that are integrated into the DDC system.
7. Logic Schematics:
   a. Provide for each system and subsystem a complete logic schematic indicating all inputs, outputs, decisions, etc.
   b. Provide schematic format which includes all of the elements defined above.
   c. Provide a legend for all symbols used.
8. Information of a general, non-project specific nature is not acceptable.
9. Start-up Testing Plan: Submit a start-up testing plan for each unique system.
   a. The purpose of a start-up test is to demonstrate the "completeness" of the physical tasks associated with installation and the physical performance of the components.

E. Submittals After Construction:
1. Start-up Testing Report.
   a. Start-up testing reports shall be submitted on a per system basis.
   b. Start-up testing reports shall be the documented results of the executed start-up testing plans.

2. Operating and Maintenance Instructions: For all system components requiring maintenance include all maintenance information as required in Division 01 Section “Submittal Procedures” in addition to the following:
   a. Descriptive System Information: Include system logic schematics, input/output functions and Sequences of Operation.
   b. Operating Instructions: Include schedules and procedures for starting, stopping, cleaning, protection, testing, adjustments, calibration and replacement of components.
3. As-Built Documentation:
   a. Upon completion of the installation, and prior to acceptance by the Owner's representative, HI&C Contractor shall furnish as-built documentation and should include, but is not limited to the following:
      1) Points list in accordance with processor.
      2) Process flow diagram.
      3) Location plans.
      4) Operating sequences.
   b. All changes to the above submitted drawings, equipment descriptions and operation manuals shall be clearly identified on the as-built documentation.
4. Software:
   a. Submit a copy of all software installed on the servers and workstations.
   b. Submit all licensing information for all software installed on the servers and workstations.
   c. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
   d. Submit all licensing information for all of the software used to execute the project.
   e. All software revisions shall be as installed at the time of the system acceptance.
5. Firmware Files:
   a. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
      1) This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
   b. Submit a copy of all application files that were created during the execution of the project.
   c. Submit a copy of all graphic page files created during the execution of the project.
   d. Submit a copy of all secondary graphic files such as bitmaps, jpegs, etc. that were used in the creation of the graphic pages.

1.8 QUALITY ASSURANCE

A. Fabrication, Programming and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.
   3. 3 years minimum experience in the design and installation of HI&C work similar to that specified herein.

B. Pre-Approved Installers: The following organizations are acceptable and are considered to meet the qualification requirements of this project:
   1. Siemens Building Technologies, Inc., Grand Rapids, Michigan.

C. Regulatory Agencies Requirements:
   1. All temperature control wiring shall comply with NEC.
   2. All pneumatic piping installation shall comply with all state and local codes and ordinances.
   3. All smoke detectors shall bear the UL label and be FM approved.
   4. All components used for smoke control shall comply with UL864.
   5. All DDC I/O Devices (Specified and Future):
      a. ASCII (American Standard Code for Information Interchange) coded.
      b. Furnished with EIA (Electronic Industries Association) interface hardware.
   6. All instrumentation hardware shall be ISA (Instrument Society of America) compatible.
   7. All primary components of DDC hardware shall be UL listed (UL916).
   8. Installation shall comply with FCC (Federal Communications Commission) rules for Class A and Class B computing devices pursuant to Subpart J of Part 15.
   9. ASHRAE Standard 135, BACnet/IP.
   10. Network wiring shall comply with EIA/TIA Standards.

1.9 WARRANTY

A. In addition to the warranty provisions defined in the General Conditions, provide an extended warranty of a minimum 1 additional year (2 years total).

1.10 SERVICE AGREEMENT

A. Provide 12-month service and maintenance contract paid in full:
   1. Within 30 days after Substantial Completion.
   2. Signed by Manufacturer's authorized representative.

B. Programming and Setpoint Adjustments:
   1. In addition to service and maintenance, include 40 hours for adjustments in setpoints, reset schedules, and sequence revisions as directed by the Owner to "fine tune" control systems to building and occupant characteristics through 1 year of seasonal changes under full operation.
   2. Documentation:
      a. Submit documentation of actual time spent for programming and setpoint adjustments within 30 days after completion of the work for approval by Owner or Engineer.
      b. Time spent for service and maintenance as included above is not part of this allotment and is to be documented separately.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

A. The Owner shall retain all rights to software for this project.

B. The Owner shall sign a copy of the Manufacturer’s standard software and firmware licensing agreement as a condition of this Contract. Such license shall grant use of all programs and application software to the Owner as defined by the Manufacturer’s license agreement, but shall protect the Manufacturer’s rights to disclosure of trade secrets contained within such software.

C. The licensing agreement shall not preclude the use of the software by individuals under contract to the Owner for commissioning, servicing or altering the system in the future. Use of the software by individuals under contract to the Owner shall be restricted to use only for the purpose of commissioning, servicing or altering the installed system.

D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
   1. Server and workstation software.
   2. Application programming tools.
   3. Configuration tools.
   4. Addressing tools.
   5. Application files.
   6. Configuration files.
   7. Graphic files.
   8. Report files.
   9. Graphic symbol libraries.
   10. All documentation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. General:
   1. Provide a micro-processor based logic system using low voltage electricity as a communication medium with an open architecture and distributed intelligence.
   2. All controlled components, sensors and controllers shall be addressable except:
      a. Terminal heating units such as unit heaters, cabinet heaters, convectors, finned tube.
      b. Ventilation fan and damper systems serving a single room and moving 1,000 cfm or less.
      c. Variable air volume (VAV) boxes.

3. Provide completely computerized system using low voltage electricity as the operating medium.
4. System Functions:
   a. Digital operation in accordance with preprogrammed strategies to control temperatures, energy use and selected electrical/mechanical equipment.
   b. Capable of mathematical computation and logical/relational functions as required to achieve specified control strategies.
   c. Capable of off-loading programs and accumulated data to magnetic media and a web browser.
   d. Provide battery-powered RAM devices for program storage.
   e. Continuous self-checking capability.
   f. English language message display for all alarm and fault conditions.

B. Interoperablility:
1. Provide a distributed, peer-to-peer BAS using BACnet as defined by ANSI/ASHRAE Standard 135.
2. Architecture shall not require continuous operation of a central server, workstation, cloud service, protocol gateway, or supervisory controller for execution of local control sequences.
3. Controllers shall execute assigned control, scheduling, alarm, and energy-management functions during loss of communication with BAS server or operator workstation.
4. Proprietary protocols may be used only within factory-packaged equipment where approved. Provide a native BACnet interface at the packaged-equipment boundary.
5. Gateways shall not be used between controllers furnished under this Section where native BACnet communication is commercially available.
6. BACnet controllers, routers, servers, and operator workstations shall be BTL listed for proposed device profiles when an applicable listing is available. Submit a current PICS for each BACnet device type.

C. System Architecture: Provide the following logical network levels as applicable:
1. Management-Level Network: Ethernet-based network supporting BAS servers, operator workstations, web clients, databases, and approved enterprise interfaces.
2. Automation-Level Network: Ethernet-based BACnet network connecting building controllers, system controllers, major equipment controllers, and approved routers.
3. Field-Level Network: BACnet/IP, BACnet/SC, or BACnet MS/TP network serving application-specific and terminal-equipment controllers.
4. BACnet Secure Connect:
   a. Devices connected to a BACnet/SC network shall comply with applicable requirements of ANSI/ASHRAE Standard 135 and use encrypted WebSocket communications and certificate-based device authentication.
   b. Provide primary and failover hub functions where required by approved network design. Hubs may be dedicated appliances, embedded devices, or controller-resident functions suitable for continuous operation.
   c. BACnet/SC-ready devices shall be convertible to native BACnet/SC through a Manufacturer-supported firmware or software update without controller replacement. Identify dependencies, licensing, tools, and limitations.
5. Network Expansion:
   a. Design architecture for not less than twice the installed system object or point count through addition of controllers, network devices, and field wiring. Expansion shall not require replacement of BAS server, operator workstation, primary network architecture, or software platform unless identified in accepted proposal.

D. Networking:
1. All devices that connect to the LAN/WAN shall be capable of operating at 10 megabits per second or 100 megabits per second.
2. LAN/WAN To Field Bus Routing Devices:
   a. A BACnet Building Controller shall be used to provide this functionality.
   b. These devices shall be configurable locally with RS232 or IP crossover cable and configurable via the LAN/WAN.
   c. The routing configuration shall be such that only data packets from the field bus devices that need to travel over the LAN/WAN level of the architecture are to be forwarded.

2.2 MANUFACTURERS

A. Subject to compliance with interoperability requirements and these Specifications, hardware, software, and components shall be supplied by and bear the name of 1 or more of Manufacturers listed below. Alternate Manufacturers are also listed in this Specification for individual components.

B. Acceptable Manufacturers:
   1. Siemens Building Technologies, Inc.

C. Stocking Requirements: All valves, operators, standard electrical components, and other replaceable parts shall be normally stocked within a 100 mile radius of the job Site.

D. Electrical Components: Provide electrical components as specified in Division 26 and as manufactured by the acceptable Manufacturers listed therein.

2.3 HARDWARE SYSTEM REQUIREMENTS

A. System Architecture:
   1. Provide hardware comprised of a local building level primary controller and local control modules.
   2. User programmable.
   3. Provide Communication Networks:
      a. Local links for distributed programming, data interchange and control at all system levels.
      b. Web server for remote access through Internet lines to all system functions and levels with firewall and VPN hardware device.
   4. Standalone capability for local control modules.
   5. Analog Input:
      a. Analog sensing elements for remote indication to be independent of local sensors used for local control loops.
      b. The A/D conversion resolution shall not exceed 0.01 volts per count.
   6. Binary Input:
      a. Air flow status for each fan shall be indicated by means of a differential pressure sensing device which opens an electrical contact as the differential pressure falls below an adjustable pressure range setting.
   7. Output Control:
      a. Provide the necessary relays and wiring required to start and stop points, specified on the point list, through their respective existing control circuit.
      b. Wiring required to complement the following control functions:
         1) Auto: In the auto control, the existing control sequence is not changed.
         2) Close: In the close control, the controlled device is maintained in the fully closed position.

B. System Features:
   1. Modular construction and interoperable protocol to ensure future expansion capability with interconnection of system modules.
   2. Software configurable input and output points.
   3. Expandable Point Capacity:
      a. At any point along the network without hardwiring points back to a central control panel.
      b. Provide a minimum of 10% spare outputs user configurable for digital or analog.
      c. System shall be modularly expandable to at least twice the installed capacity using additional hardware.

C. System Communication:
   1. High Speed LAN and/or WAN Based, Arcnet or Ethernet Compatible: Capacity for a minimum of 2 operator stations, allowing concurrent multiuser, multitasking access to DDC network and control units.
   2. Provide transparent peer-to-peer communication between all control panels.
   3. Support an Internet communication link utilizing standard Internet protocol.
   4. Provide Internet browser capabilities allowing transparent interfacing with all the functionality of the head end user station, through remote control software.

D. Operator Interface:
   1. Provide fully programmable remote web based access allowing alarm management and setpoint and schedule adjustments.
      a. User interface shall be graphical in accordance with requirements below.
   2. Building Level Processor:
      a. Run and print reports on specific equipment including AHUs, pumps, terminal units, boilers, etc.
      b. Monitor and edit equipment scheduling parameters.
      c. Receive and monitor alarms.
      d. Exchange data (read and edit) between all the various control panels.
      e. Receive and send data such that, from an off Site work station, all the functions listed under Items a, b, c, and d above, can be performed without the addition of new hardware or software.
   3. At Local Control Modules:
      a. Peer-to-Peer Communications:
         1) Through an operator interface device, such as a laptop, hand held computer or touch pad screen, transparent interfacing to all other control panels shall be achieved such that it shall be as if being connected to the other control panel itself, without having to set up any separate communication services.
         2) Data, status information, reports, system software, custom programs, sensor data, etc., for all controllers shall be available for viewing and editing purposes.
      b. Any Manufacturer's HVAC equipment using either LONtalk or BACNet control and communication protocol provided with it, could be installed and connected at any time to the control panel system and transparently provide all sequence of operation controlling points and alarms, as if it came with the central control system's brand name controls on it, without having to add additional equipment.
      c. Additional input and output points can be conveniently added via adding expansion modules.
   4. Application Software (latest versions reside on microcomputer):
      a. Input/output capability from operator station.
      b. System access level via software password.
      c. Database creation and support.
      d. Dynamic color graphic displays.
      e. Alarm processing.
      f. Event processing.
      g. Data collection.
      h. Full building graphics development.
      i. Maintenance management.
      j. Control software.
      k. Report writing.
      l. Trending applications.
      m. Control Manufacturer's internet website server link.
   5. Portable Access Device: Furnish a hand-held control system interface device that will be used during commissioning and will be turned over to Owner upon completion of Project.

E. Primary Controller:
   1. Features:
      a. Building-level control system, with on-board storage of programs and data, and with monitoring capabilities over all points in the building system.
      b. Capable of standalone operation, supervising local control modules without a host computer.
      c. Built-in, password-protected, multi-function keypad/display providing complete access to building-level monitoring and control.
      d. RS-232-C port for connecting an optional ASCII terminal and/or printer to supplement the built-in keypad/display terminal.
      e. Equipped with multiple processors, battery backup of RAM, and a battery backed-up real time clock.
   2. Functions:
      a. Supervise all necessary building and energy management functions programs, including global data distribution (phase/power loss, outdoor temperature, external alarm status), time-of-day scheduling, holiday scheduling, optimized start/stop, duty cycle control, demand control, run time logging, equipment and system alarm monitoring, and self-diagnostics.
      b. Network of local control modules (up to 256 input/output control points).

F. Secondary Controller:
   1. General:
      a. Provide input/output, electronic thermostat, and terminal box controller modules as indicated on the Drawings and as required to satisfy the functional intent description of this Section.
      b. Microprocessor-based with on-board program storage.
      c. Capable of functioning as the input/output interface between the system and the building/equipment environment, providing control and management functions as programmed.
      d. Capable of built-in bi-directional communication capability, over 2-wire cable or Ethernet, with the Primary Processor for programming and reporting functions and for supervision of all control and energy management operations.
      e. Standalone capability to maintain programmed local control functions and operations including direct digital control in the event communications with the Primary Processor are lost.
      f. Equipped with timed override switches to allow programmed off-hours operation.
      g. Provide with LED indicators or LCD display to show schedule status, output status and communication status.
   2. Input/Output Modules:
      a. Capable of the following local control capabilities:
         1) Supervisory and closed loop control.
         2) Setpoint and setback control.
         3) Positioning control.
         4) Proportional reset.
         5) Status monitoring.
         6) Equipment alarms.
         7) Sequencing (staging).
      b. Local parameters and settings shall be monitorable and modifiable through the Primary Processor keypad/display terminal.
      c. Perform energy and building management functions under supervisory control from the Primary Processor.
      d. After initial communication with the Primary Processor, standalone programmed capabilities shall be stored on-board, in memory with 2,000 hour battery backup.
      e. Equipped with 8 inputs and 8 outputs which shall be software configurable as either analog, digital or pulsed digital.
      f. Configuration:
         1) Inputs and outputs shall be surge and spike protected.
         2) Inputs shall employ noise immunity circuits.
         3) Outputs shall employ noise suppression circuits.
         4) Outputs shall be equipped with internal manual/auto selection capability for local maintenance and troubleshooting use.
         5) Provide suitable intermediate devices where the load being controlled exceeds the rating of the output, or uses a different operating medium.
   3. Electronic Thermostat Modules:
      a. Provide modules capable of the following:
         1) All necessary programmed functions.
         2) Energy and building management.
         3) Local control and monitoring.
      b. Features Required:
         1) Automatic downloading by Primary Processor.
         2) Standalone operation after initial Primary Processor communication.
         3) RAM memory storage for failsafe, fixed setpoint program items.
         4) Permanent ROM memory storage for failsafe, fixed setpoint program items.
      c. Local control functions include, but are not necessarily limited to:
         1) Cooling sequencing.
         2) Heating sequencing.
         3) Scheduling.
         4) Fan on/off.
         5) Mixed air damper modulation.
         6) Temperature setback.
         7) Optimized start and stop.
         8) Timed override.

d. Provide for input device signal interface:
   1) Temperature Sensor: 4-20 mA.
   2) Air flow switch.
   3) Override pushbutton.

4. Terminal Box Controller Modules:
   a. Provide modules capable of the following:
      1) All necessary programmed functions.
      2) Energy and building management.
      3) Local control and monitoring.
      4) Integrating Primary Processor functions into local programs.
   b. Features Required:
      1) Automatic downloading by Primary Processor.
      2) Standalone operation after initial Primary Processor communication.
      3) RAM memory storage for failsafe, fixed setpoint program items.
      4) Permanent ROM memory storage for failsafe, fixed setpoint program items.
   c. Local control functions include, but are not necessarily limited to:
      1) Damper positioning.
      2) Fan start/stop.
      3) Reheat coil valve modulation.
      4) Temperature setback.
      5) Timed override.
   d. Provide for input device signal interface:
      1) Temperature Sensor: 4-20 mA.
      2) Air flow switch.
      3) Override pushbutton.

G. Rooftop Unit Controls:
   1. Rooftop unit Manufacturer to provide controller modules as indicated on the Drawings and as required to satisfy the functional intent description of this Section. Refer to Division 23 Section "Packaged, Outdoor Heating and Cooling Units."
      a. Microprocessor based with on-board program storage.
      b. Capable of functioning as the input/output interface between the system and the building/equipment environment, providing control and management functions as programmed.
      c. Capable of built-in bi-directional communication capability, over 2-wire cable, with the Primary Processor for programming and reporting functions and for supervision of all control and energy management operations.
      d. Standalone capability to maintain programmed local control functions and operations including direct digital control, in the event communications with the Primary Processor are lost.
      e. Equipped with timed override switches to allow programmed off hours operation.
      f. The DDC system control panel shall be capable of communicating with each individual rooftop and monitoring various points. There shall be 1 controller per rooftop that communicates back to the main control panel.
   2. The RTU controller shall be capable of monitoring and communicating the following information back to the system control panel:
      a. Analog Input Points:
         1) Outdoor air temperature.
         2) Supply air temperature.
         3) Space air temperature.
         4) Return air temperature.
         5) Active setpoint.
         6) Outdoor air relative humidity (%).
         7) Space air relative humidity (%).
         8) Outdoor air damper position.
         9) Return air damper position.
         10) Space carbon dioxide level.
      b. Binary Input Points:
         1) Smoke/fire alarm status.
         2) Heating status.
         3) Economizer enable/disable status.
         4) Hot condenser gas reheat, coil enable/disable status.
         5) Supply fan on/off status.

6) Supply fan failure.
7) Exhaust fan on/off status.
8) Exhaust fan failure.
9) Cooling contactor status.

3. The system control panel shall provide the following control functions for each RTU:
   a. Schedule all RTUs for heating night setback.
   b. Schedule all RTUs for a heating morning warm-up.
   c. Schedule night setup during cooling.
   d. Schedule all RTUs for optimum start and provide a program that automatically adjusts on a daily basis the morning start-up time based on the zone temperature versus the occupied setpoint and the historical recovery rate for each unit.
4. Remote Sensors:
   a. Air Temperature Sensor:
      1) See location detail on the Drawings.
   b. Each zone shall be provided with a temperature and a carbon dioxide sensor (where applicable).
   c. Sensors shall provide input to the RTU controllers.
   d. Sensors shall be located as indicated on the Drawings.

2.4 SOFTWARE SYSTEM FEATURES

A. Siemens Desigo CC Management Platform:
1. Provide Siemens Desigo CC as the integrated building management platform. The platform shall furnish a common operator environment for building automation and, where included, power management, fire safety, access control, intrusion, video, industrial PLC, and other integrated disciplines.
2. Provide a scalable client-server architecture supporting combined server/client installation and separately deployed Windows App, Web, or Flex clients. Where additional segregation or connectivity capacity is required, provide Siemens Desigo CC Front End Processor configurations.
3. Provide graphical operation, alarm and event management, schedules and calendars, online and offline trends, reports, audit and activity logs, macros, JavaScript-based scripting, automated reactions, and remote notifications. Configure user-specific scopes, views, and privileges.
4. Provide long-term online storage and archive management capable of retaining operational data for more than 10 years, with configurable recording groups and the ability to remount offline archived data.
5. Provide native or supported interfaces, as applicable to the Contract Documents, for BACnet and BACnet/SC, OPC DA and OPC UA, Modbus TCP, SNMP, M-Bus, KNX and KNX Secure, Siemens S7 and S7 secure communication, and IEC 61850.
6. Provide Siemens SORIS southbound integration framework for approved custom adapters and Siemens NORIS northbound REST web services for authorized external applications to read and write real-time data and access events and historical values subject to Owner permissions.
7. Provide Siemens Desigo CC BIM functionality where indicated, supporting IFC4 and IFC2x3 models, bidirectional navigation between system objects and model equipment, runtime values and status, commands, events by area, 2D floor plans, and available equipment documentation.
8. Provide the Siemens Desigo CC connector for Microsoft Power BI where indicated to share authorized building data for dashboards, visualization, and reporting. Identify all required licenses and configuration in the proposal.
9. Where cloud connectivity is included, provide authorized connectivity from the Siemens Desigo system to Siemens Building X applications. Cloud connectivity shall not be required for execution of local control and shall comply with Owner cybersecurity approval.

B. Enterprise Data Access and Integration:
1. Provide documented, standards-based methods for authorized external applications to access BAS data without interfering with local control, operator-interface performance, alarms, trends, schedules, or controller-to-controller communication.
2. External applications shall not directly control equipment unless write access is specifically authorized by Owner. All interfaces shall comply with Owner cybersecurity and network requirements.

C. Supported Interfaces: Provide interfaces indicated in Contract Documents from the following: BACnet/IP; BACnet/SC; OPC Unified Architecture; secure REST-based web services; structured database or reporting interface; and scheduled export in CSV or another Owner-approved nonproprietary format.

D. Data Access and Export:
   1. Authorized users and applications shall be capable of accessing applicable real-time values, historical values, trend data, alarm and event information, equipment status, operating modes, energy and meter data, setpoints, calculated values, and point metadata.
   2. Exported data shall include timestamp, point identifier, engineering units, value, and quality or status where supported, and shall be suitable for common spreadsheet, database, analytics, and visualization applications.

E. Secure Web Services: Where required, provide authenticated and encrypted web services with documented endpoints, supported requests, data structures, dependencies, limitations, error responses, permissions, and a method for disabling write access.

F. Analytics and Visualization: Provide a documented method for an Owner-authorized analytics or visualization platform to access BAS data using a standards-based connector, secure web service, database interface, or scheduled export. Identify required licenses, middleware, servers, gateways, and recurring fees in proposal.

G. Acceptance Testing: Demonstrate authorized connection, retrieval of representative real-time and historical data, correct timestamps and units, enforcement of permissions, recovery after interruption, continued BAS operation during interface interruption, and export to an Owner-approved external application.

H. The programmable energy and building management functions include, but are not necessarily limited to:
   1. User Setpoint Control:
      a. Time Of Day Scheduling:
         1) Capable of optimally starting based on individual unit recovery ramps.
         2) Time of day scheduling shall be continuous, such that if power is lost, on power up, the panel will look back for each device to see whether it should be on/off or in occupied/unoccupied temperature setpoints.
      b. Holiday and weekend schedules.
      c. Space temperature setpoint control.
      d. Space humidity setpoint control.
      e. Space ventilation setpoint control.
      f. Timed Override:
         1) Each scheduled device shall be able to be overridden at the operator work station to the occupied mode for up to 4 hours.
         2) The override shall also be cancelable from the operator work station at any time during the override.
   2. System Controller Features:
      a. Temperature reset.
      b. Economizer control (free cooling).
      c. Temperature control.
      d. Humidity control.
      e. Terminal box grouping.
      f. Power fail restart sequencing.
      g. PID loop control.
      h. Data logging.
      i. Duty cycling.
      j. Optimized start/stop.
      k. Demand limit control.
      l. Control to greatest demand, with the ability to ignore specific demand inputs.
      m. Event Log: The last 100 events shall be maintained for review at the OWS and remotely.
      n. Daylight Savings Time:
         1) The system panel software shall automatically update time according to daylight savings at the legislated time and date, and reset time at the end of the daylight savings period.
         2) This function shall be able to be disabled.
   3. Control programs include, but are not necessarily limited to:
      a. Setpoint (closed loop).
      b. Proportional reset.
      c. Sequencing by time and/or temperature.
      d. Limit and status monitoring.
      e. Local emergency overrides.

f. Local timed schedule overrides.
g. Outdoor temperature operating limits.

4. Capable of combining functions as required for specific user requirements.

I. User and Programmer Access:
1. User password protected.
2. Programmer password protected.

J. Custom Programming:
1. Provide a user-friendly, interactive, "on-line" programming language for the purpose of creating custom programs for specific, unique applications.
2. All custom programming must be performed in English language commands, and all inputs, outputs, variables and flags shall be addressable by user specific English names without requiring alphanumeric addresses or point numbers.
3. The system shall be programmable to allow or secure each of the above setpoint controls at each level.

K. Logs/Alarms:
1. Provide automatic logging of control alarms, critical alarms, kW demand history and kWh consumption.
2. Additional logging shall be programmable including, but not limited to:
   a. Equipment run time.
   b. Historic trends and logs.
   c. User defined meters.
   d. User access logs and point scans.
3. Provide alarm monitoring and reporting capabilities for all input points, including phase loss alarms, external alarms, load control alarms, critical alarms with auto-dial-up feature, alarm summary on printer, including time and date of alarm, and programmable power-failure restart sequence.
4. Audible Alarms:
   a. Provide audible alarm at building level processor for each alarm condition.
   b. Provide operator silencing. Reset daily.
5. At Control Panel Systems:
   a. Peer-To-Peer Communications:
      1) Through an operator interface device, such as a laptop, hand held computer or touch pad screen, transparent interfacing to all other control panels shall be achieved such that it shall be as if being connected to the other control panel itself, without having to set up any separate communication services.
      2) Data, status information, reports, system software, custom programs, sensor data, etc., for all controllers shall be available for viewing and editing purposes.
   b. Any Manufacturer's HVAC equipment using either LONtalk or BACNet control and communication protocol provided with it, could be installed and connected at any time to the control panel system and transparently provide all sequence of operation controlling points and alarms, as if it came with the central control system's brand name controls on it, without having to add additional equipment.
   c. Additional input and output points can be conveniently added via adding expansion modules.
   d. Run and print trends of selected equipment performance characteristics in table and graph forms.
   e. Run and print reports on specific equipment including AHUs, pumps, terminal units, chillers, boilers, towers, etc.
   f. Monitor and edit equipment scheduling parameters.
   g. Receive and monitor alarms.
   h. Manage the network including monitoring of the loss of communication and clock setting functions.
   i. Exchange data (read and edit) between all the various control panels.
   j. Receive and send data such that from another control Manufacturer's PC work station off Site from the primary head end, all the functions listed under Items a, b, c, d, e and f, above, can be performed without the addition of new hardware or software.

L. Program Descriptions:
1. Time-Of-Day Scheduling:
   a. Decrease energy consumption by turning off loads during unoccupied hours or unoccupied days.
   b. Programmable in 1 minute increments.
   c. Up to 64 discrete schedules in accordance with Primary Processor system.
   d. Up to 16 groups of loads (consisting of up to 16 loads each) for concurrent scheduling.

e. Ability to assign loads to existing alternate schedules by linking.
f. Timed overrides and temporary "today" and "tomorrow" schedules, for each schedule.

2. Setpoint/Setback Control:
   a. Decrease energy consumption by modifying space temperature setpoints during scheduled unoccupied hours, thereby reducing use of mechanical heating or cooling.
   b. Timed override off hours setpoint operation.
3. Optimized Start/Stop:
   a. Decrease energy consumption by learning building response to changing weather and automatically turning on HVAC as late as possible in the morning and off as early as possible in the evening, while meeting ambient temperature requirements during occupied hours.
   b. Optimized start and stop times updated daily.
4. Holiday Scheduling:
   a. Allow up to 16 holiday periods to be programmed.
   b. Each holiday period programmable for a maximum of 99 consecutive days.
5. Duty Cycle Control:
   a. Decrease kWh consumption by shedding and restoring electrical loads on a cyclic basis to reduce total on time.
   b. Programmable cycle interval and on time.
   c. Minimum off and on times to prevent damage to equipment.
   d. Demand peak limit on initial start by staggered on times.
6. Demand Limit Control:
   a. Monitor and control demand kW for up to 128 loads.
   b. Able to monitor up to 4 electric meter or pulse type watt transducers.
   c. Maintain demand peak limit by turning loads on and off, or by adjusting setpoints, to keep peak below a programmed setpoint.
   d. Based on 30-second integration of demand, the rate of increase or decrease, and the historic effects of load shedding and restoring.
   e. Programmable minimum on times, minimum off times, maximum off times, temperatures and other limits and overrides.
   f. Programmable shedding and restoring in rotational/sequential order with 4 levels of priority.
7. Temperature Reset:
   a. Capable of user-defined linear proportional reset functions.
   b. Programmable reset parameters, variables and limits.
   c. Variables programmable as the highest, lowest or average of multiple inputs.
8. Economizer Control (Free Cooling):
   a. Reduce energy consumption by utilizing outside air for cooling:
      1) Enthalpy based.
      2) In lieu of mechanical cooling equipment.
   b. Programmable to operate fan systems during unoccupied hours of the cooling season in the maximum outside air mode.
9. Direct Digital Temperature Control:
   a. Maintain automatic temperature control directly by the local control module microprocessor.
   b. Local module capable of performing all necessary local control functions.
10. Terminal Box Grouping: The DDC shall be able to group VAV boxes via keyboard commands. These terminal unit groups shall make it possible to:
    a. Send a common command to all boxes in a group to operate in the same mode.
    b. Offset heating or cooling setpoints of 1 or more terminal unit groups by an adjustable amount.
    c. Receive and display information on a group basis, including, but not necessarily limited to:
       1) Minimum group temperature.
       2) Maximum group temperature.
       3) Average group temperature.
       4) Current airflow through boxes in group.

2.5 ELECTRICAL DEVICES AND WIRING

A. Comply with all local codes and applicable Sections in Division 26 of these Specifications.

B. Low Voltage Wiring (24V or Less):
   1. Installed in a ceiling plenum used for return air shall be plenum rated wire securely fastened in accordance with the requirements of Division 26.
   2. Exposed wiring shall be installed in accordance with the requirements of Division 26.

C. Approved Manufacturers:
   1. Honeywell.
   2. Siemens.
   3. Allen-Bradley.
   4. GE.
   5. Square D.

D. Limit Switches: Limit switches shall be oil tight type with appropriate operator to provide required function. Limit switches used on dampers should be set at approximately 75% of full stroke.

E. Control Relays and Contactors:
   1. Relays shall be a minimum DPDT, of proper coil voltage, with indicator light, and of sufficient rating for specified purpose. Relay base shall be of the screwed terminal type.
   2. Contactors shall be definite purpose type, have adequate number of poles, of proper coil voltage, and of sufficient rating for specified purpose.

F. Selector Switches:
   1. Switches shall be multiple position type, oil-tight, watertight, dust-tight, have the adequate number of contact blocks, capable of additional contact blocks, and of sufficient rating for specified purpose.
   2. Nomenclature plate shall be provided with appropriate wording, units, etc.

G. Push Buttons and Pilot Lights
   1. Push button switches and pilot lights shall be, oil-tight, watertight, dust-tight, have the adequate number of contact blocks, capable of additional contact blocks, and of sufficient rating for specified purpose.
   2. Nomenclature plate shall be provided with appropriate wording, units, etc.
   3. Pilot lights shall be LED, push-to-test type with replaceable lamps and lens. Lens shall be of the appropriate color for application served.

H. Environment:
   1. All devices shall be of the correct NEMA rating for the environment in which it is installed.
   2. Refer to Electrical Drawings for area classifications.

2.6 ELECTRIC INSTRUMENTS

A. Thermistor Temperature Sensors and Transmitters:
   1. Accuracy: ± 0.5 degrees F (0.3 degrees C) at calibration point.
   2. Wire: Twisted, shielded pair cable.
   3. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sf (0.84 sq. m).
   4. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
   5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
   6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
      a. Setpoint Adjustment: Concealed.
      b. Setpoint Indication: Concealed.
      c. Thermometer: Concealed.
   7. Outside Air Sensors: Watertight inlet fitting, shielded from direct sunlight. Provide vandal resistant enclosures where accessible to the public.

B. RTDs and Transmitters:
   1. Accuracy: ±0.2 percent at calibration point.
   2. Wire: Twisted, shielded-pair cable.
   3. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
   4. Averaging Elements in Ducts: 24 feet (7.3 m) long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
   5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).

6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   a. Setpoint Adjustment: Concealed.
   b. Setpoint Indication: Concealed.
   c. Thermometer: Concealed.
7. Outside Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. Low Temperature Detection:
1. Provide Electric Thermostat:
   a. With 20-foot sensing element installed in a serpentine manner across the coil face area.
   b. 2-position manual reset type with adjustable differential and of range to match the application.
2. Provide multiple thermostats wired in series as required to provide complete coil area coverage.
3. Shut down the unit supply fan upon detection of a low temperature along any 1-foot length of its sensing element.

D. Static Pressure Transducer:
1. Factory installed and wired in the control box.
2. The transducer shall have a range of 0 to 5-inch W.G. and shall have an accuracy of ±2% of the range, including nonlinearity and hysteresis.
3. The static pressure probe shall be field installed 2/3 down the duct or as indicated on the Drawings.

E. Differential Air Pressure Switch:
1. The differential air pressure switch shall be factory installed across the supply fan inlet and discharge and field wired to the fan relay.
2. The switch shall be SPDT and shall include a manual reset button.
3. The switch shall be factory set at 3.0-inch W.G. and shall have the ability of being field adjusted over a range of 1.4-inch to 6.0-inch W.G.

F. Relative Humidity Transmitter:
1. Polymer film capacitance change type.
2. Temperature compensated.
3. Accuracy: ± 2%.
4. Range: 0 – 100% relative humidity.
5. Ambient Temperature: 0 – 120 degrees F.
6. Output Signal: 4 to 20 mA or 0 to 10 VDC, as required.
7. Manufacturers:
   a. General Eastern Instruments Corporation.
   b. Vaisala, Inc.

G. Dew Point Transmitter:
1. Saturated salt lithium chloride type.
2. Accuracy: ±1 degree F.
3. Range: 12 to 99% relative humidity.
4. Ambient Temperature: -40 to 140 degrees F.
5. Input Power: 24 VDC or 115 VAC, as required.
6. Manufacturers:
   a. General Eastern Instruments Corporation.
   b. Vaisala, Inc.

H. Carbon Dioxide Sensor:
1. Manufacturer and Model: Johnson Controls, CDS-2000-2; or approved equal.
2. Description: Carbon dioxide sensor using non-dispersive infrared (NDIR) sensing technology to measure carbon dioxide and provide a 1-10 VDC output signal corresponding to 2-2000 parts per million (ppm) concentration of carbon dioxide.
3. Components:
   a. Carbon dioxide sensor capable of measuring carbon dioxide concentration in air from 0-2000 ppm.
   b. 24V AC transformer to power carbon dioxide sensor.
   c. Supply air flow filter which inhibits sensing chamber contamination.
   d. 2 front-mount wiring terminals blocks.

4. Performance Requirements:
   a. Accuracy: ±100 ppm carbon dioxide.
   b. Repeatability: ±20 ppm carbon dioxide.
   c. Drift: ±100 ppm carbon dioxide per year.
   d. Response Time: Less than, or equal to 30 seconds maximum.
   e. Airflow Rate: 500 milliliters per minute at 1.4 psi ±10% through 1/4-inch O.D. tubing.

2.7 GAGES

A. Comply with the requirements of Division 23 Section “Meters and Gages for HVAC Piping.”

B. Air Pressure Gages:
   1. Provide 1-1/2-inch diameter gages at all input sensor lines, switch lines, branch side of each controller and at each controlled device.
   2. Stem or surface mounted as required.
   3. Compatible with tubing size.

C. Temperature, Humidity and Pressure Indicators:
   1. Dial type having a minimum diameter of 3-1/2 inches, adjustable calibration, and accuracy of ±1/4% of dial range.
   2. Thermometer ranges to match the range of the transmitter with which used.
   3. Furnish for all transmitters as described in the Functional Intent article of this Section.

D. Alternate Manufacturers: As listed in Division 23 Section “Meters and Gages for HVAC Piping.”

2.8 AUTOMATIC CONTROL VALVES AND ACTUATORS

A. Furnish valves in accordance with the requirements of Division 23 Section “General Duty Valves for HVAC.”

B. Control Valve Actuators:
   1. Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.
   2. Provide 2-position actuators for unit heaters, cabinet unit heaters, and equipment automatic isolation valves.
   3. Provide modulating service for all other control valves unless specifically indicated otherwise.
   4. Close-off (Differential) Pressure Rating:
      a. Hydronic Systems: Combination of actuator and trim shall provide minimum close-off pressure rating of 150% of total system (pump) head for 2-way valves and 100% of pressure differential across valve or 100% of total system (pump) head.
   5. Provide with neck extension on insulated service
   6. Electric Actuators and Motors:
      a. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
         1) Johnson.
         2) Honeywell.
         3) Belimo Aircontrols (USA), Inc.
         4) Siemens.
      b. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
      c. Serviceable and rebuildable.
      d. Coupling: V-bolt and V-shaped, toothed cradle.
      e. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
      f. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.

2.9 INSTRUMENT TEST HOLES

A. Provide surface mounted, flanged test holes with removable caps and of sufficient length to extend beyond external duct insulation.

B. Install at all control points in ductwork, including, but not necessarily limited to:
   1. Discharge air controllers.
   2. Return air controllers.
   3. Mixed air controllers.
   4. Pressure sensors.
   5. Limit thermostats.
   6. Temperature sensors.

C. As manufactured by Ventfabrics, Inc.; Ventlock, Model 699; or equal.

2.10 CONTROL PANELS

A. Located within mechanical equipment rooms.

B. UL listed for line voltage system with removable face panel.

C. Furnish in Manufacturer's standard color.

D. Constructed and installed in accordance with Article 409 of the NEC (NFPA 70).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Electrical Wiring:
   1. Motor Starters:
      a. Provide independent control circuit to each motor starter contactor coil.
      b. Provide a normally open interlock contact in each motor starter to indicate contactor status at DDC.
      c. Provide one electrically separate, normally open contact to start or stop each motor controlled by the system.
   2. Limit Interlocks:
      a. Wiring of limit interlocks and dampers shall include on-off-auto switch on speed controllers.
      b. Wiring of all limit interlocks shall be such that the equipment will be de-energized in all operating positions of the starter.
   3. Provide separate branch circuits for all 120 VAC power serving DDC equipment and related components.

B. Outside Air Transmitters:
   1. Locate on a north exterior wall.
   2. Do not locate in fresh air ducts.

C. Duct Pressure Sensors:
   1. Locate and set duct static pressure sensors as indicated on the Drawings or as instructed by the Engineer.
   2. Allow for one relocation and one reset of each static pressure sensor as instructed by the Engineer at no additional cost to the Owner.

3.2 FIELD QUALITY CONTROL

A. Cybersecurity Acceptance Testing:
   1. Before final acceptance, verify that default credentials are changed or disabled; unused ports and services are disabled; user roles and permissions operate as approved; secure communications and certificates operate correctly; audit logs are generated and retrievable; backup and restoration procedures are successful; and local control continues following loss of server, workstation, or network communication.

B. Demonstration and Acceptance Test:
   1. Operate each and every phase of the control system separately, or in conjunction one with the other:
      a. For a sufficient period of time to demonstrate the ability of the system to meet performance requirements in accordance with the true intent and purpose of these Specifications.
      b. Provide for notification and approval of Engineer as required by Division 01 Section “Starting and Adjusting.”
   2. The HI&C Subcontractor is responsible for verifying and demonstrating that each Sequence of Operation is being performed and design conditions stably maintained under operating conditions.
   3. Acceptance of performance will be provided by the CxA.
   4. Provide 8 hours of field service time for demonstration and acceptance test. Additional costs required due to retesting due to failure of system to perform satisfactorily shall be the responsibility of HI&C Subcontractor.

C. Operator Instruction:
   1. During system commissioning, and at such time acceptable performance of the system hardware and software has been established, provide onsite operator instruction to Owner's operating personnel.
   2. Operator instruction during normal working hours shall be performed by competent Manufacturer's representative familiar with the software, hardware and accessories.
   3. At a time mutually agreed upon during system commissioning as stated above, provide 8 hours of instruction to Owner's designated personnel on the operation of all equipment within the system and describe its intended use with respect to the programmed functions specified.
   4. Includes, but is not necessarily limited to:
      a. The overall operational program, equipment functions (both individually and a part of the total integrated system).
      b. Commands.
      c. Advisories.
      d. The appropriate operator's intervention required in responding to the system's operation.
      e. A description of the chronological information flow from field sensors, contacts and devices to the centrally located control console.
      f. The overview of the system's communication network to acquaint the operator of the interplay between initiating devices, remote processing units, loop communications and their importance within the operating system.
   5. Provide additional information time, as deemed necessary by Owner's authorized representative, on a negotiated basis with Owner.

D. Troubleshooting: Comply with the requirements of Division 23 Section “General HVAC Provisions,” Article 1.7, for troubleshooting.

3.3 ADJUSTMENTS AND CALIBRATION

A. Upon completion of this Project, adjust and validate all thermostats, controllers, valves, damper operators, relays, and other components provided as part of the temperature control system.

B. Calibration:
   1. After completion of installation, the pneumatic piping shall be tested for leaks.
   2. Provide calibration documentation to Engineer, which shall include:
      a. Airflow transmitter calibration curves to relate the transmitter output signal to the actual airflow as well as to the pressure drop across the primary flow measuring element.
      b. For pressure, differential pressure, flow, and other transmitter's provide calibration curves using the zero, span and 3 other points between 10% and 90% of span. These curves shall relate the output signal of the transmitter to the primary measured value.
      c. Indicating instruments shall read true conditions and be checked with test instruments.
      d. Calibration of temperature and humidity sensors.

C. Adjustments, Tuning and Start-up:
   1. After the completion of calibration, adjust and tune the controls.
   2. Provide documentation, which is to include:
      a. Input/output relationship of all controllers, positioners, and final drive units.
      b. Gains and time constants established in all controllers.
      c. Loop setpoints.
      d. Limits on control actions.
      e. Alarm limits.
      f. Control dead bands.
   3. Provide seasonal adjustments as required under Article 1.10 – Service Agreement.

END OF SECTION 23 09 00

SECTION 23 20 19 – PIPING SPECIALTIES FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of piping specialties.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Specifications:
      a. A126 – Gray Iron Castings for Valves, Flanges and Pipe Fittings.
      b. A216 – Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
      c. A193 – Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
      d. A278 – Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F.
   2. ANSI Standards:
      a. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
      b. B16.5 – Pipe Flanges and Flanged Fittings.
      c. B16.24 – Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300.
   3. ASME American Society of Mechanical Engineers:
      a. Boiler and Pressure Vessel Code – Section II.
      b. B31.1 – Power Piping.
      c. B31.5 – Building Services Piping.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all items listed in PART 2 – PRODUCTS. Include dimensions, details of construction and installation, name of Manufacturer, and model.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Except as otherwise indicated on the Drawings or specified herein, the manufactured units and flow measurement devices shall be supplied by one of the following:
   1. Amtrol (Expansion Tank).
   2. Apollo.
   3. Armstrong Pumps, Inc.
   4. Bell & Gossett.
   5. Caleffi.
   6. Deiterich Standard Corp. (Flow Indicators).
   7. Flow Design, Inc. (Circuit Setter).
   8. Nexus.
   9. Spirotherm, Inc.
   10. Taco, Inc.

2.2 TERMINAL UNIT VALVE PACKAGES

A. Provide in accordance with Division 23 Section “General Duty Valves for HVAC.”

B. Terminal unit coil valve packages are acceptable. For terminal unit reheat coils, unit heaters, fan coils, , provide valves and piping specialties as indicated in the coil details on the Drawings.
   1. Supply Side: Shut off valve, pressure and temperature plug, and union.
   2. Return Side: Separate shut off valve, auto control valve, strainer, circuit setter [automatic balancing valve], pressure and temperature plug, and union.
   3. If any combination valves are provided, a separate shut off valve is still required for isolation of all other valves, specialties, and coil.
   4. Components of manufacturer provided valve packages shall meet the valves and specialties in these Sections. Control valves shall be as specified in Division 23 Section “Instrumentation and Control for HVAC.”
   5. In addition to manufacturers listed in Division 23 Section “General Duty Valves for HVAC”, valve packages by Victaulic (Tour and Anderson), Flow Design, and Bell and Gosset may be provided.

2.3 MANUFACTURED UNITS

A. Expansion Tank (Atmospheric):
   1. ASME construction, 125 psi, 375 degrees F with National Board Form U-1.
   2. Size: .
   3. Tank fitting for proper air control in the tank:
      a. Designed for 125 psig working pressure.
      b. Include a manual vent for adjusting the air volume in the expansion tank.

B. Air Separator and Strainer:
   1. ASME, 125 psi, 375 degrees F with National Board Form U-1.
   2. Strainer Material: Galvanized.
   3. Diameter Holes: 3/16-inch.
   4. Free Area: 5 times pipe area.
   5. Blow Down Connection: Yes.
   6. Size: As indicated on the Drawings.

C. Strainer (Water Systems):
   1. ASME, 125 psi, 375 degrees F.
   2. Strainer Material: Galvanized.
   3. Diameter Holes: 3/16-inch.
   4. Free Area: 5 times pipe area.
   5. Blow Down Connection: Yes.
   6. Size: As indicated on the Drawings.

D. Pressure Relief Valve:
   1. ASME rated, diaphragm-operated, type with cast iron body and brass internals.
   2. Provide as indicated on the Drawings.
   3. Valve pressure setting compatible with system operation.
   4. 125 psig maximum working pressure; 250 degrees F maximum operating temperature.

2.4 FLOW MEASUREMENT DEVICES

A. Size:
   1. Select size to provide design flow at mid-range of scale.
   2. Do not use pipe size as basis of selection.

B. Flow Indicator:
   1. Preso Model AR Ellipse; or equal:
      a. With mounting hardware and 2 instrument valves per sensor.
      b. All stainless steel construction.

2. Provide brass 1/4-inch SAE flare safety shutoff instrument valves with 1/8-inch NPT fittings, and permanent means of indicating flow characteristics for each device.
3. Install at all points indicated on the Drawings by the symbol F.I.

C. Circuit Setter (Flow Rates 2 gpm and Above):
1. Manufacturer and Model:
   a. Bell & Gossett Model CB calibrated balancing valve.
   b. Armstrong Model CBV circuit balancing valve.
   c. Taco Model CS circuit setter.
   d. Flow Design Model AS Accusetter.
   e. Tour & Anderson Series 780.
2. Bronze body construction with integral globe valve, differential pressure readout ports and threaded drain connection.
3. Rated for 300 psig/250 degree F operating conditions.
4. Readout ports include caps and internal check valves.
5. Furnish with calibrated name plate and memory stop.
6. Furnish [1] Model RO-2 readout kit.
7. Not acceptable for use as shutoff/isolation valve.

D. Circuit Setter (Flow Rates Less Than 2 gpm):
1. Manufacturer and Model:
   a. Armstrong Model APV Venturi with a throttling ball valve.
   b. Flow Design Model AS Accusetter.
   c. Tour & Anderson Series 780.
2. Bronze body construction with integral brass ball valve, venturi flow element, and differential pressure readout ports.
3. Rated for 300 psig/250 degree F operating conditions.
4. Readout ports include caps and internal check valves.
5. Furnish with memory stop.
6. Furnish 1 readout kit.
7. Not acceptable for use as shutoff/isolation valve.

2.5 COIL AUTOMATIC BALANCING DEVICES

A. Automatic balancing valves shall be based on Griswold. Automatic balancing valves by the following Manufacturers of the same size, type, capacity and meeting other requirements may be furnished at the Contractor's option and shall be by the same Manufacturer.
1. Flow Design.
2. Flow Set.

B. Install automatic balancing control valves on the coil return side of reheat coils, unit heaters and elsewhere as indicated on the Drawings and shall be a combination valve. A flow control valve installed on supply piping will not be allowed. Furnish valves with full port ball valve, flow control cartridge, 2 P/T plugs and double union. The required pump head loss not to exceed 7.4 foot head, with control range of 2-32 PSID. For larger higher head systems, provide with a nominal 4-57 PSID range cartridge and with a maximum head loss of 13.4 feet.

C. Valves:
1. For 1/2-inch through 2-inch: Brass alloy body, rated no less than 250 psi/250 degrees F.
2. For 2-1/2-inch through 3-inch: Threaded flange type grey iron, rated no less than 300 psi/250 degrees F.
3. For 4-inch through 12-inch: Grey iron Class 150 wafer type.

D. Flow Control Cartridge Assembly:
1. Precision ground, stainless steel and be removable without breaking piping for sizes 3-inch and less.
2. Valve: Be capable of controlling flow within 5 percent of rated flow.

E. Manufacturer shall supply certified independent laboratory tests verifying accuracy of performance of products.

F. A combination unit consisting of full port ball valve, full size strainer with drain valve and cap, and union may be furnished in lieu of field piped devices on the supply piping as indicated on Drawings.

2.6 FABRICATIONS

A. Heat Transfer Package:
   1. At Contractor's option, converter, expansion tank, air separator, pumps and accessories may be provided as a pre-piped, frame-mounted package such as Model "HTP" by Bell and Gossett.
   2. Comply with the requirements of the following:
      a. Division 23 Section “Hydronic Pumps.”
      b. Division 23 Section “Heat Exchangers for HVAC.”
      c. All requirements and piping orientations as indicated on the Drawings.

2.7 BELLOWS TYPE EXPANSION JOINTS

A. Bellows type expansion joints for iron and steel piping for condensate system shall be constructed with 2 ply stainless steel bellows and carbon steel shrouds, and end fittings.
   1. Acceptable units are Model HP by Metraflex; or equal by other acceptable manufacturers.

B. Bellows type expansion joints for hot water systems with copper piping shall be constructed from 2 ply phosphor bronze bellows, brass shrouds and end fittings.
   1. All internal parts shall be of non-ferrous metal.
   2. Acceptable units are Model HP by Metraflex; or equal by other acceptable manufacturers.

C. Bellows expansion joints, for installation in domestic hot water system copper piping shall be all stainless steel with no carbon steel parts, multi-ply stainless steel, type 316, bellows.
   1. Bellows shall be welded with minimum number of longitudinal seams and no circumferential seams.
   2. The joints shall be single or double with center anchor base where indicated and scheduled, with Vanstone rolled face flanges.
   3. The joints shall be rated for 125 pounds operating pressure and 500 degrees F maximum operating temperature.
   4. Flanged joints shall be provided with 316 stainless steel flanges.

D. All flanged expansion joints must be installed using a 100% PTFE gasket, Interlex SQ-S or other approved.

2.8 SLIP TYPE EXPANSION JOINTS

A. Manufacturer:
   1. Advanced Thermal Systems, Inc., Thermal Pak Type TP2.
   2. Yarway Corporation "Gun-Pakt."
   3. Hyspan Series 6500 Perma-Pax.

B. Provide single slip type, packed expansion joints of fabricated steel with bronze integral internal and external guides, fully packed, welded ends, bases as indicated on the Drawings, designed for 150 psi (90 psi working pressure) with traverse distances as indicated on Drawings.

C. Fabricate the body and slip of ASTM A53, Grade B, seamless steel pipe, Schedule 40 for steam service and Schedule 80 for condensate service. Provide the joint with stainless steel limit stops designed for full line pressure thrust at 3.0 times or greater design pressure.

D. Equip expansion joints with carbon steel packing cylinders with internal acme thread and a carbon steel cylinder body with external acme thread welded in place on the circumference of the joint and fitted with a 1/4-turn shut off valve or check fitting to prevent blowback, allowing the addition of semi-plastic self-lubricating packing under full line pressure.

E. Each expansion joint shall have the following number of packing cylinders located on the circumference of the joint:

PIPE SIZE (NPS)	NO. OF CYLINDERS
1-1/4" – 3"	2
4"	2
5" – 6"	3
8" – 10"	4
12" – 14"	5
16" – 18"	6
20" – 24"	8

F. Provide Manufacturer's guarantee that all joints are free from defects in materials and workmanship for a period of 5 years from the date they are put into service.

G. Factory Testing:
1. Cycle test each expansion joint and record test data for each joint.
2. Hydraulically cycle each expansion joint 3 times after packing inspection to ensure free movement for the total rated traverse.
3. Provide Cycle Test Results with Joint Friction Loading for Full Stroke at 150 psi Steam Loading, for each expansion joint.
4. Testing shall be conducted by the Manufacturer or by an approved independent testing agency (Owner approved).

H. Each expansion joint shall be complete with weatherproof reusable insulation blanket furnished and manufactured by joint Manufacturer or by pre-approved custom fabricator. Blanket shall be 2 piece design, custom made to fit expansion joint body and slip side of joint. Inside diameter of insulation on slip end shall be equal to the outside diameter of adjoining pipe and insulation. Packing glands must be accessible for service without removing blanket. Material shall be suitable for damp installations, exposure to salt, and for temperature to 550 degrees F. Insulation blanket shall be 2 inches thick; equal to ATS, MT550 NN.

2.9 EXPANSION LOOPS

A. Size: As indicated on Drawings.

B. Material: ASTM A53 Grade "A" seamless steel pipe, schedule to match pipe.

C. Long radius elbows.

2.10 MANUAL AIR VENTS

A. Manufacturer: Bell & Gossett or Dole.

B. Size: 1/8-inch.

C. Type: Slotted head (Bell & Gossett 4V or Dole No. 9).

D. Location:
1. All cabinet, unit heaters and air handler, and coils.
2. At all high points in the piping.
3. Wherever called for on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all piping specialties in conformance with:
   1. The Shop Drawings reviewed by Engineer.
   2. The Manufacturer's recommendation.

B. Furnish and install all vibration isolators, flexible connections, expansion joints, expansion loops required to reduce noise transmissions and stress on equipment and piping.

C. Cold spring all piping installed with expansion joints and loops half of the total expansion. This requirement does not reduce the amount of expansion compensation required of the loop or joint.

3.2 EXPANSION JOINTS

A. New Expansion Joints:
   1. Support and align the pipe to guarantee proper operation of the expansion joint prior to installing the new expansion joint. Alignment of the pipe is considered essential to the Work of this Contract.
   2. Align the pipe with use of a laser device, measurements shall be taken in 2 planes (horizontal and vertical) 90 degrees from each other. Adjust the pipe support guides, and/or anchor connections as necessary to provide proper axial movement into the expansion joint according to the Manufacturer's specifications, and current standards.
   3. Strictly adhere to the following installation procedures and the Manufacturer's instructions for installing the slip type expansion joints:
      a. Align the pipe (see Items 1 and 2, above) and install the pipe supports, hangers and guides between the 2 main anchors making sure the pipe is aligned.
      b. Perform required testing.
      c. Cut the piping out where the expansion joint is to be installed and check for pipe movement or springing. This step is to be scheduled with the [Engineer] [Owner] 1 week in advance.
      d. Carefully protect the slip surface from damage during handling and installation.
      e. Expansion joint will be shipped at a preset ambient temperature, normally 70 degrees F (21 degrees C). If the ambient temperature at the time of installation is colder or hotter, then adjust the travel of the expansion joint as required.
      f. Cut or extend the pipe opening to match the expansion joint's length.
      g. Align and weld expansion joint to the piping according to Manufacturer's recommendations and Contract Documents.
      h. Contractor shall provide a pipe support for the expansion joint when required by Manufacturer or code, or both. Provide a concrete pad under the support to protect from moisture and corrosion.
      i. Lubricate expansion joints in accordance with Manufacturer's recommendations prior to activation. Relubricate as necessary during activation and prior to final acceptance.
      j. Contractor shall have a Manufacturer's representative inspect each expansion joint after installation.

B. Existing Expansion Joints:
   1. Support and align the pipe to guarantee proper operation of the expansion joint prior to installing the new expansion joint. Alignment of the pipe is considered essential to the Work of this Contract.
   2. Align the pipe with use of a laser device, measurements shall be taken in 2 planes (horizontal and vertical) 90 degrees from each other. Adjust the pipe support guides, and/or anchor connections as necessary to provide proper axial movement into the expansion joint in accordance with the Manufacturer's specifications and current standards.
   3. Strictly adhere to the following installation procedures and the Manufacturer's instruction for installing the slip type expansion joints:
      a. First align the existing pipe (see Items 1 and 2, above) and replace the pipe supports, hangers, and guides between the 2 main anchors making sure the pipe is aligned.
      b. Cut the existing expansion joint out and check for any pipe movement or springing. This step is to be scheduled with the [Engineer] [Owner] 1 week in advance.
      c. Carefully protect the slip surface from damage during handling and installation.

d. Expansion joint will be shipped at a preset ambient temperature, normally 70 degrees F (21 degrees C). If the ambient temperature at the time of installation is colder or hotter, then adjust the travel of the expansion joint as required.
e. Cut or extend the existing pipe opening to match the new expansion joints length.
f. Align and weld expansion joint to the piping according to Manufacturer recommendations and Contract Documents.
g. Contractor shall provide a pipe support for the expansion joint when required by Manufacturer and/or code. Provide a concrete pad under the support to protect from moisture and corrosion.
h. Lubricate expansion joints in accordance with Manufacturer's recommendations prior to activation. Relubricate as necessary during activation and prior to final acceptance.
i. Contractor shall have a Manufacturer's representative inspect each expansion joint after installation.

END OF SECTION 23 20 19

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a hydronic piping and circulation system for heating hot water.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. American Society of Mechanical Engineering (ASME):
      a. B31.1 – Code for Pressure Piping.
      b. B31.9 – Code for Building Services Piping.
      c. Power Boiler Code.
      d. Heating Boiler Code.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all products listed in Part 2.
   1. General:
      a. Dimensions.
      b. Details of construction and installation.
      c. Name of Manufacturer.
      d. Model number.
   2. Air Separator and Suction Diffuser:
      a. Performance curve.
      b. Itemized list by Tag Number giving head and flow characteristics.
   3. Flow Measurement Devices:
      a. Flow and pressure drop curves.
      b. List each application with flow and size clearly indicated.

B. Operation and Maintenance Manuals: For all flow measurement devices.
   1. Equipment function, normal operating characteristics and limiting conditions.
   2. Assembly, installation, adjustment and checking instructions.
   3. Maintenance instructions.
   4. Guide to "troubleshooting".
   5. Parts lists and predicted life of parts subject to wear.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

1.6 MAINTENANCE

A. Valve and Vent Schedule:
   1. Provide the following schedules:
      a. Air Vents: Indicate air vent number and location of all manual air vents that are not attached to a univent, heating unit, ventilating unit or other equipment.
      b. Valves: Indicate valve number, location and function of all valves.
   2. Mount schedules under plexiglass in the Mechanical Room.

PART 2 - PRODUCTS

2.1 PIPE AND FITTING APPLICATIONS:

A. General:
   1. Comply with the requirements of Division 23 Section “Steel Pipe and Fittings for HVAC.”
   2. Comply with Application requirements below.

B. Hydronic:
   1. For Piping Through 2-Inch to 75 psig:
      a. Pipe: Black Steel, Schedule 40, ASTM A53 or A106, ERW or seamless, Grade B.
         1) Fittings: Cast Iron, ASTM EB16.4, 150 pound.
         2) Joints: Screwed.
      b. Pipe: Seamless Copper, Type L, ASTM B88:
         1) Joints: 50/50 Solder.
         2) Fittings: Wrought Copper.

C. Cooling Coil Condensate Drainage System:
   1. Provide a condensate collection pan for each above-the-ceiling cooling unit piped to nearest sanitary drain riser.
   2. Trap piping as indicated on Drawings and pitched 1/8-inch per foot minimum.
   3. Pipe size to match drain pan connection or as indicated on Drawings.
   4. For interior building systems, use Type L copper pipe and hangers. Wrought copper fittings and 50/50 solder:
      a. Insulation is required for interior building condensate drain piping.

D. Condensate From High Efficiency Gas Fired Appliances:
   1. Refer to specific manufacturer installation guidelines for piping and installation requirements.
   2. Piping from the appliance to condensate trap and from condensate trap to acid neutralization kit must be CPVC, high-temperature silicone tubing, galvanized, or stainless steel, and be free of leaks.
      a. Copper pipe, carbon steel/iron pipe or PVC pipe are not acceptable.
   3. Piping from the acid neutralization kit to the floor drain may use PVC or CPVC piping in lieu of other types listed above.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install piping and circulation system in accordance with:
      a. The Drawing.
      b. These Specifications.
      c. The Shop Drawings reviewed by Engineer.
      d. The Manufacturer's recommendations.
   2. System shall not interfere with passage, head room or openings of doors and windows.
   3. Pipe: Straight, without rust or other defects.

4. Joints:
   a. Welded: Required for pipes 2-1/2 inches and larger.
   b. Screwed:
      1) Reamed after cutting and before threading.
      2) Sharp, clean threads.
      3) Use pipe compound on male threads only.

B. Mains and Branches:
   1. Install above the ceiling and in bar joists, above bottom chord, as indicated on the Drawings.
   2. Sizes as indicated on the Drawings.
   3. Install Tops of Mains Level:
      a. Use eccentric fittings at changes in pipe size.
      b. Provide adequate supports to prevent air pockets.
   4. Branches:
      a. Take off bottom of main.
      b. Provide swing connection before vertical riser to a heating unit or convector.

C. Risers and Vertical Pipes: Plumb, straight and without unnecessary fittings or offsets.

D. Fittings:
   1. Provide Air Vents:
      a. As indicated on the Drawings.
      b. At all high points on the system.
   2. Provide Drain Valves:
      a. At the bottom of all risers.
      b. At boiler.
      c. At all low points.
   3. Provide insulating couplings or unions where copper and steel pipes are joined.
   4. Provide unions at all valves and at all equipment for making repairs.

E. Valves:
   1. Provide Shutoff Valves:
      a. On both sides of all pumps where necessary to ensure proper operation of the system.
      b. On all branches at the main.
      c. So that equipment can be serviced without shutting down the system.
   2. Provide unions at all valves and at all equipment for making repairs.

3.2 GROOVED PIPING SCHEDULE

Grooved Piping Application Schedule				
	Application	Design Temperature Range	Maximum Pressure	Acceptable Pipe/Coupling (See Note Below)
	Heating/air conditioning	-30 to 230 degrees F	300 psig	A, B
Note – Pipe/Coupling Types:				
A.	Standard weight steel pipe.			Refer to Section 23 05 03
B.	Copper tubing			Refer to Section 23 05 09

END OF SECTION 23 21 13

SECTION 23 21 23 – HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the HVAC pumps.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. American Society of Mechanical Engineers (ASME):
      a. B31.9 – Code for Building Services Piping.
   2. Underwriter's Laboratories, Inc. (UL).
   3. ASHRAE 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-rise Residential Buildings, with state amendments.

1.4 SUBMITTALS

A. Manufacturer's Literature: For each pump.
   1. Pump make and model designation.
   2. Pump efficiency at design.
   3. Dimensions.
   4. Total head at design.
   5. Shut off head.
   6. Required NPSH at design.
   7. Motor Manufacturer, type and characteristics.
   8. BHP required at design conditions.
   9. List of construction materials.
   10. Performance Curves: With NPSH curves.
   11. Project specific wiring diagrams including control wiring.

B. Operation and Maintenance Manuals: For each pump.
   1. Equipment function, normal operating characteristics and limiting conditions.
   2. Assembly, installation, alignment, adjustment and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   4. Lubrication and maintenance instructions.
   5. Guide to "troubleshooting".
   6. Parts lists and predicted life of parts subject to wear.
   7. Outline, cross-sections, assembly drawings, engineering data and wiring diagrams.
   8. Test data and performance curves.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

1.6 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered in original, unbroken, brand marked containers.

B. Handle and store materials in a manner which will prevent deterioration and contamination with foreign matter.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace removed materials at no additional cost to Owner.

1.7 WARRANTY

A. Pumps shall be furnished with a 1 year manufacturer's parts warranty. Manufacturer shall provide start up services.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bell & Gossett.

B. Armstrong Pumps, Inc.

C. Taco.

2.2 MANUFACTURED UNITS

A. Wet Rotor Inline Pump:
   1. Provide a wet rotor inline pump, in cast iron or lead free stainless steel body construction specifically designed for quiet operation. Suitable standard operations at 230 degrees F and 175 PSIG working pressure.
   2. The Pump Internals: Be capable of being serviced without disturbing piping connections.
   3. Equipped with a water-tight seal to prevent leakage.
   4. Pump Volute: Be of a cast iron design for heating systems. The connection style on the cast iron and stainless steel pumps shall be flanged.
   5. Flange Dimensions: HVAC industry standard 2 or 4 bolts sizes.
   6. Motor: Be a synchronous, permanent-magnet (PM) motor and tested with the pump as 1 unit. Conventional induction motors will not be acceptable.
   7. Each motor shall have an Integrated Variable Frequency Drive tested as 1 unit by the manufacturer. Pump should not be used with an external VFD.
   8. Integrated Motor Protection: Verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).
   9. Pump shall have MODBUS or BACnet communication capability.
   10. Analog inputs, such as 0-10V and 4-20mA, are standard inputs built into the VFD.
   11. Pumps shall be UL 778 listed and bear the UL Listed Mark for USA and Canada with on-board thermal overload protection.
   12. Each pump shall be factory performance tested before shipment.
   13. Operating Modes:
      a. As appropriate from the following to achieve pump control sequence of operation on the Drawings:
         1) Proportional Pressure: The differential pressure will continuously increase or decrease along a linear curve based on the flow demand.
         2) Constant Pressure: The pump maintains a constant differential pressure set by the user at any flow demand until the maximum speed is reached.
         3) Constant Speed: The pump maintains a constant speed at any flow rate
         4) Night Set Back: The pump will recognize a 10 degrees C water temperature reduction and will switch to nighttime operation.
         5) T-Constant: This control will use a PI algorithm to vary the speed of the pump in order to maintain a constant temperature of the fluid media.

6) Delta-T Constant: This control mode will use a PI algorithm to vary the speed of the pump in order to maintain a constant differential temperature between the built-in temperature sensor and external temperature sensor.
7) Delta-P-T: This control mode is paired with proportional or constant pressure mode. The nominal differential pressure setpoint will vary according to the fluid temperature.
8) Delta-P-Delta-T: This control mode is paired with proportional or constant pressure mode. The nominal differential pressure setpoint will vary according to the differential temperature between the built-in temperature sensor and external temperature sensor.

14. Two Pump Control:
    a. Backup: This mode will start the second pump in case of failure to the master pump.
    b. Alternate Operation: This mode will run one pump at a time. The working time is switched every 24 hours.
15. Installation:
    a. Make the reduction from line size to pump connection size with eccentric reducers attached to the pump with tops flat to allow continuity of flow and to avoid air pockets.
    b. Pumps are supplied with an integrated VFD and should not be used with any external VFDs.
    c. Pumps shall NOT be run dry to check rotation.

2.3 COMPONENTS

A. Motors: Comply with the requirements of Division 23 Section “Common Motor Requirements for HVAC Equipment.”

2.4 SOURCE QUALITY CONTROL

A. Factory align and run test pumps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pumps in conformance with:
    1. The Drawings.
    2. These Specifications.
    3. The Shop Drawings reviewed by Engineer.
    4. The Manufacturer's recommendation.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Arrange and pay for Manufacturer's engineer to provide the services indicated below. Schedule the following as soon as practicable after installation, and at times approved by Engineer and Owner.
    1. Manufacturer's Engineer: Check work, assist in start-up, demonstrate operation and maintenance to Owner's personnel, and review operation and maintenance manual with Owner's personnel.

B. Promptly make changes and additions required by Manufacturer's engineer.

C. Submit Manufacturer's engineer's written approval of installation. A factory trained and authorized local technician may be used.

END OF SECTION 23 21 23

SECTION 23 23 00 – REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Liquid refrigerant lines.
   2. Refrigerant lines.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASME Standards:
      a. B31.5 – Refrigeration Piping.
   2. AHRI Publications:
      a. 710 – Dryers, Liquid Line.
      b. 730 – Suction Line Filters and Filter Dryers, Flow-Capacity Rating and Application of.
   3. ASHRAE Publications:
      a. 15 – Safety Code for Mechanical Refrigeration.
      b. 17 – Method of Testing Capacity Rating of Thermostatic Refrigerant Expansion Valves.
      c. 63.1 – Methods of Testing Liquid Line Refrigerant Driers.
   4. Copper Development Association – "Copper Tube Handbook".

1.4 QUALITY ASSURANCE

A. Qualifications for fabrication and installation personnel:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Type I and Type II Technician certification in accordance with EPA issued regulation 40 CFR 82 Subpart F.

B. Requirements of regulatory agencies:
   1. All refrigerant system components shall be UL listed.
   2. All state and local codes and ordinances.
   3. Owner's insurer.

C. Testing of complete system in accordance with this Section and Division 23 Section “Testing and Cleaning of HVAC Systems.”

1.5 WARRANTY

A. If at any time during the warranty period the system loses its charge, the Contractor shall again repair leaks, leak test, evacuate and charge in accordance with this Specification.

B. Warranty Period: Two years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sporlan.

B. Mueller.

C. Refrigeration Specialties.

D. Alco.

E. Phillips.

F. Flexonics.

G. Keflex.

2.2 EQUIPMENT

A. Piping (ACR Copper, Type L):
   1. Liquid lines.
   2. Suction or discharge lines.
   3. Condensate lines.

B. Pipe Insulation: Armaflex 22: 1/2-inch wall thickness, mil.

C. Fittings:
   1. Wrought copper recessed for silver brazing joints.
   2. Use long radius ells.

D. Joints: All joints shall be made in accordance with the limits, as outlined in Copper Development Association Copper Tube Handbook Table No. 11 titled, Rated Internal Working Pressures of Joints Made of Copper Water tube and Solder, parallel to the rotating device.

E. Flexible Vibration Absorbers:
   1. Corrugated/braided type, nonporous bronze alloy installed on suction and discharge refrigerant lines.
   2. Wrapped with vapor barrier tapes to prevent frost formation.
   3. Comply with the requirements of Division 23 Section “Sound and Vibration Control for HVAC.”

F. Valves:
   1. Valves shall be the packless type with gas-tight cap seal.
   2. Provide relief valves in accordance with codes.
   3. Vent lines from relief valves shall be full size and run to the outside of the building.

G. Strainers:
   1. Designed to permit removing screen without removing strainer and piping system.
   2. 80 mesh or smaller.
   3. Location:
      a. In each liquid line before the thermostatic expansion valve.
      b. In suction lines to each refrigerant compressor not equipped with integral strainer.

H. Liquid Moisture Indicators: Provide in liquid line serving each thermostatic expansion valve.

I. Dehydrator:
   1. Provide in each liquid line near the receiver.
   2. Angle type permitting replacement of dehydrating element without removing body from line.
   3. Sized to match capacity of systems.
   4. With line size connections.
   5. Provide stop valves on each side of dehydrator.

J. Pressure and Temperature Gages:
   1. Dials shall be graduated in pounds per square inch, and also in corresponding refrigerant temperature, in accordance with the following:
      a. Suction Pressure: Vacuum 30 to 150 psig and corresponding temperature.
      b. Discharge Pressure: 0 to 300 psig and corresponding temperature.

K. Expansion Valves:
   1. External equalizing, adjustable type.
   2. Select for loads and pressures involved; avoid oversizing.
   3. Install valves as close to evaporator inlet as possible and without bends or elbows between valve and distributor.
   4. Thermal Bulbs:
      a. Clamp to suction line near the evaporator outlet in a horizontal position at the top of suction lines 7/8-inch O.D. and smaller and at 4:00 or 8:00 on larger lines.
      b. Do not locate bulbs where they will be affected by other suction lines or temperature sources.
      c. Ensure a good contact with the pipe with use of proper clamps.
      d. Insulate suction lines and bulb as required.
   5. Connect equalizer line to the suction line at a point on the compressor side of the bulb unless otherwise instructed by the evaporator Manufacturer.

L. Solenoid Valves:
   1. Installed in liquid refrigerant line serving each unit cooler or cooling coil as a primary refrigerant flow control device permitting or stopping flow of refrigerant to automatic expansion valve.
   2. Moisture and vaporproof and of corrosion resisting materials.
   3. Designed for intended service.
   4. Positive opening and closing action.

M. Back-Pressure Regulating Valves:
   1. Pilot-operated.
   2. Designed and installed to prevent excessive short-cycling of refrigerant compressor-motor during periods of refrigeration loads less than built-in capacity reduction ability of compressor.
   3. Designed for proportionally throttling flow of refrigerant (suction) gas to compressor.

PART 3 - EXECUTION

3.1 REFRIGERANT PIPING SYSTEM

A. Joints:
   1. All refrigerant piping joints shall be reamed, thoroughly cleaned and silver soldered or brazed.
   2. Use Stay-Silv silver solder flux, and Stay-Silv No. 15 brazing rod or Stay-Silv No. 1200 silver solder.
   3. Nitrogen gas shall be passed through the piping during the entire silver soldering process at a minimum rate of 75 fpm.
   4. Location shall be accessible for repair and replacement.

B. Vibration Isolation:
   1. All refrigeration piping shall be suspended and run in such a way as to prevent transmitting vibrations or rattles into the building.
   2. Supports for all horizontal and vertical refrigerant piping shall be Unistrut System with Uni- cushion rubber isolation strip.
   3. Use vibration eliminators in horizontal sections before and after vertical riser.
   4. Where pipes pass through walls, they shall run through concentric metal sleeves with pipe insulation.
   5. Comply with the requirements of Division 23 Section “Sound and Vibration Control for HVAC.”

C. Liquid Lines:
   1. Installed with strainers, solenoid valves, shutoff valves, dehydrators, liquid indicators and dryers.
   2. As specified in this Section.

D. Suction Lines:
   1. Installed with heat exchanger, shutoff valves, and strainers.
   2. As specified in this Section.
   3. Total suction line friction from any evaporator to compressor manifold shall not exceed pressure equivalent to a 2 degree temperature drop from the specified evaporator refrigerant suction temperature.

E. Size:
   1. In accordance with:
      a. Manufacturer's instructions.
      b. Latest edition of the ASHRAE Guide.
   2. Sizes indicated on Drawings are for estimation purposes only.

F. Miscellaneous:
   1. Provide oil loops at all coils and risers.
   2. Pitch All Lines:
      a. In direction of flow.
      b. 1/2-inch per 10 lineal feet minimum.
   3. All refrigeration valves and accessories shall be disassembled and/or protected from overheating and damage during the brazing process.

3.2 TESTING AND EVACUATION

A. Each Refrigeration System:
   1. Pressure Test:
      a. Pressure test using nitrogen (N2) gas.
      b. Pressurize the system to 25 psig.
      c. Check for leaks.
      d. Once the system is tight, pressurize with additional nitrogen and small amount of refrigerant to obtain minimum rated design pressure.
      e. Hold this pressure for 12 hours.
      f. Notify Engineer 24 hours in advance of test.
   2. Evacuation:
      a. Evacuate to 500 microns (reading must be taken from a system point furthest away from the vacuum pump).
      b. Hold for 12 hours with the pump isolated.
      c. Must be witnessed and approved by Engineer's representative prior to breaking the vacuum.
      d. On large systems, evacuation may be done in sections, as long as positive isolation can be achieved.

B. Extreme care shall be taken to ensure maximum cleanliness of all refrigerant piping.

C. Piping shall be dehydrated in an approved manner.

D. Pipe covering shall not be installed or piping anchored until testing is complete and all leaks properly eliminated.

3.3 CHARGING AND START-UP

A. Charging:
   1. HVAC:
      a. Pressurize the system to above 32 degrees F saturated with gas only if the system incorporates water cooled condensers or liquid chillers.
      b. The balance of the charge may be introduced as liquid into the condenser, receiver or liquid line.
      c. Each refrigerant system shall be charged with sufficient refrigerant to fill the system plus 15% for liquid seal.

B. Startup:
   1. Operate the system for a period of at least 48 hours.
   2. Check strainers for pressure drop during this period.
   3. Renew if excessive drop occurs.
   4. During initial system start up:
      a. Change filter driers.
      b. Clean Strainers:
         1) As dictated by system pressure drop.
         2) After 72 hours maximum of initial system operation.
   5. A qualified service representative shall check out the system to ensure installation, operation and performance. The representative shall instruct Owner's operating personnel responsible for system operation.

END OF SECTION 23 23 00

SECTION 23 25 00 – HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a complete water treatment system for closed circuit hydronic, condenser water and boiler systems including, but not limited to, the major items listed below:
   1. Shot-type pot feeders.
   2. Treatment chemicals: Sufficient for start-up and 1-year operation.
   3. Glycol.
   4. Water filtration systems.
   5. Test equipment.
   6. Automatic controller.
   7. Metering pumps.
   8. Water meters.
   9. Wiring.
   10. Solution tank with agitator.

1.3 SYSTEM DESCRIPTION

A. Provide complete chemical feed system to control scale, corrosion and microbiological growth in the condenser water system.

B. Provide complete chemical feed system and chemicals to control scale, corrosion and pH in the boiler system.

C. Provide complete chemical treatment to control corrosion and scale at the heating system.

1.4 PERFORMANCE REQUIREMENTS

A. Maintain water quality for HVAC systems that controls corrosion and buildup of scale and biological growth for maximum efficiency of installed equipment without posing a hazard to operating personnel or the environment.

B. Base chemical treatment performance requirements on quality of water available at project Site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction:
   1. Closed System: Maintain system essentially free of scale, corrosion and fouling to sustain the following water characteristics:
      a. Copper: [***insert value***].
      b. pH: ***[insert value of pH range***].
      c. Hardness: ***[insert valve, review basis of design boiler manufacturer requirements.***]
      d. [***insert other requirements if necessary***].

1.5 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ANSI Standard for Power Piping – B31.1.
   2. American Society of Mechanical Engineers (ASME) publications:
      a. Boiler and Pressure Vessel Code.
      b. Power Boiler Code.
   3. ASHRAE Guideline 12-2000, Minimizing the Risk of Legionellosis.

1.6 SUBMITTALS

A. Manufacturer's Literature:
   1. Name of all Manufacturers and suppliers of equipment and chemicals.
   2. Dimensions.
   3. Performance characteristics.
   4. Details of construction and installation.
   5. Electrical requirements and project specific wiring diagrams including control wiring.
   6. Data sheets on all components and chemicals, including Safety Data Sheets (SDS).
   7. System piping, including operational schematic, and wiring schematic.

1.7 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Manufacturer’s personnel shall be full-time employees of the chemical Manufacturer or authorized representative.

C. Testing of water samples in accordance with Division 01 Section “Special Inspections and Tests.”

D. Regulatory Agencies Requirements:
   1. All state and local codes and ordinances.
   2. Owner's insurer.
   3. Environmental Protection Agency (EPA):
   4. Michigan Department of Environment, Great Lakes, and Energy (EGLE).

E. Electrical wiring shall comply with NEC.

1.8 START-UP AND MAINTENANCE

A. Provide all consulting services for a period of 1 year including start-up of the water systems:
   1. Initial water analysis and recommendations.
   2. Preoperation system cleanout procedure supervision.
   3. Installation and system start-up and shutdown procedure recommendations.
   4. Training of operating personnel on proper feeding, control and maintenance techniques.
   5. Periodic field service and consultation meetings.
   6. All necessary log sheets and record forms.
   7. All required laboratory and technical assistance.

B. All services provided by a qualified, full-time representative of the chemical company.

C. It is the responsibility of the chemical supplier to obtain water Sample(s) for testing to determine the correct process and equipment to install.

1.9 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered in original, unbroken, brand marked containers.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter and damage by weather or elements in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURER/SUPPLIER

A. Chemical Treatment Equipment and Chemicals:
   1. Aqua-Chem.
   2. Enerco.
   3. Aquatrol.
   4. Nalco.
   5. Mitco.
   6. J.L. Wingert.

B. Water Filtration Systems:
   1. Process Efficiency Products (PEP).
   2. Alfa-Laval.
   3. Lakos.
   4. Harmsco.

2.2 TREATMENT CHEMICALS

A. Furnish chemicals recommended by water treatment system Manufacturer that are compatible with piping system components and connected equipment.

B. Biocide: Chlorine release agents or microbiocides.

C. Closed Loop, Water Piping Chemicals: Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors and conductivity enhancers.

D. Heating Steam and Condensate Piping Chemicals: Sequestering agent to reduce hardness and prevent feedline congestion and to provide alkalinity, oxygen scavenger, carbon dioxide neutralizer, and filming amines.

E. Open Loop, Condenser Water Piping Chemicals: Sequestering agent to inhibit scaling, acid to reduce alkalinity and pH, corrosion inhibitor and biocide.

F. Open loop piping chemicals serving humidifiers, air washers, evaporative condensers, small cooling towers and liquid coolers: Sequestering agent to inhibit scaling, corrosion inhibitor and biocide nonoxidizing.

G. Provide SDS’s on all products supplied.

H. Scale, Corrosion, and Biological Growth Control: Furnish 1 year's supply of the recommended formulas for control of scale, corrosion and biological growth:
   1. Separate products will be provided for preventing scale deposits and corrosion.
   2. The chemical products will be compatible with system materials of construction and operating conditions and will comply with all applicable regulatory agencies.
   3. No system shall be operated without the benefit of an operational chemical feed system.

2.3 WATER FILTRATION UNITS

A. Side Stream Cartridge Filter: Furnish, install and start-up a side stream cartridge filter unit equal to Harmsco Filtration Products Model HIF-[7] S.S. Rated for [30] gpm at [1.5] psi pressure drop.
   1. Casing made of stainless steel and rated to 150 psi and to 200 degrees F.
   2. Cartridge holding rods, lifters and pipe caps to be made from stainless steel.
   3. O-rings to be made of Buna-n, seals and gaskets to be made of EPDM, bottom seals of natural gum rubber.
   4. Provide with 2 sets of 20 micron cartridge filters.

5. Provide shut off valves and pressure gages on inlet and outlet pipe connections to indicate filter change out period.
6. Provide with grounding lug.

2.4 TEST EQUIPMENT

A. Furnish basic test equipment with spare reagents.

B. Reagents and Apparatus:
1. Corrosion inhibitor level.
2. pH and P & M alkalinity.
3. C12 and microbiological population for condenser water system.

PART 3 - EXECUTION

3.1 GENERAL

A. Install equipment as directed by the Manufacturer.

3.2 CLEANING SYSTEMS

A. Refer to the requirements of Division 23 Section “Testing and Cleaning of HVAC Systems.”

3.3 ADJUSTING – BOILER TREATMENT SYSTEMS

A. Sample boiler water at 1 week intervals after boiler start-up for a period of 5 weeks, and prepare certified test report for each required water performance characteristic. Where applicable, comply with ASTM D3370 and the following standards:
1. Silica: ASTM D859.
2. Steam System: ASTM D1066.
3. Acidity and Alkalinity: ASTM D1067.
4. Iron: ASTM D1068.
5. Water Hardness: ASTM D1126.

B. Occupancy Adjustments: Within 12 months of Substantial Completion, perform 2 separate water analyses to prove that automatic chemical feed systems are maintaining water quality within performance requirements specified in this Section. Perform analyses at least 60 days apart. Submit written reports of water analysis.

3.4 WATER TREATMENT SERVICE PROGRAM

A. Provide all consulting services for a period of 1 year including start-up of the water systems:
1. Initial water analysis and recommendations.
2. Preoperation system cleanout procedure supervision.
3. Installation and system start-up procedure recommendations.
4. Training of operating personnel on proper feeding and control techniques.
5. Periodic field service and consultation meetings.
6. Any necessary log sheets and record forms.
7. Any required laboratory and technical assistance.

B. All services provided by a qualified, full-time representative of the chemical company.

C. It is the responsibility of the chemical supplier to obtain water Sample(s) for testing to determine the correct process and equipment to install.

END OF SECTION 23 25 00

SECTION 23 31 13 – METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Refer to Division 23 Section “Hangers and Supports for HVAC Piping, Ductwork and Equipment” for ductwork and equipment.

1.2 SUMMARY

A. This Section includes the furnishing and installation of sheet metal ductwork, and appurtenances:
   1. As indicated on the Drawings.
   2. As specified herein.
   3. As required to provide a complete and operational air distribution system.
   4. As necessary for the proper and complete performance of the Work.
   5. Including all hangers, supports, and anchors.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

A. Comply with the requirements of Division 23 Section “Sound and Vibration Control for HVAC” for vibration isolation of ductwork.

1.4 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASHRAE Guidelines:
      a. 2000 Handbook – Chapter 16 – "Duct Construction."
      b. 2001 Handbook – Chapter 34 – "Duct Design."
      c. ASHRAE 62.1, current version.
   2. ASTM Specifications:
      a. A480 – General Requirements for Flat-Rolled Stainless Steel and Heat-Resisting Steel Plate, Sheet, and Strip.
      b. A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      c. A924 – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   3. ASTM Standard Test Methods:
      a. A90 – Weight of coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
      b. C731 – Extrudability, after Packaging, Aging, of Latex Sealants.
      c. D2202 – Slump of Sealants.
   4. NFPA Standards:
      a. 90A – Installation of Air Conditioning and Ventilating Systems.
      b. 90B – Installation of Warm Air Heating and Air Conditioning Systems.
   5. SMACNA Guidelines:
      a. "HVAC Duct Construction Standards, Metal and Flexible," Latest edition.
      b. "Rectangular Industrial Duct Construction Standards."
      c. “Round Industrial Duct Construction Standards.”
      d. “Guide for Steel Stack Construction.”
   6. UL Standards: 181 – Factory Made Air Ducts and Connectors.

1.5 SYSTEM DESCRIPTION

A. Duct sizes indicated on Drawings are net clear inside dimensions.

B. Duct Construction Pressure Classifications:

	Duct System	SMACNA Pressure Classification
1.	Supply duct downstream of VAV terminals, fan coil units, cabinet heaters	1" W.G.
2.	Supply duct upstream of VAV terminals	3" W.G.
3.	Return duct	1" W.G.
4.	Exhaust duct connected to fans: EF-1, EF-2	1" W.G.

1.6 SUBMITTALS

A. Manufacturer's Data: Sequential parts list for each part.
   1. Name of Manufacturer.
   2. Part name and model number.
   3. Dimensions.

B. Shop Drawings:
   1. Layout Drawings:
      a. Coordinated with other trades.
      b. Submit for each of the following ductwork systems:
         1) RTU-1
         2) RTU-2
         3) EF-1
         4) EF-2
      c. Refer to example provided at end of this Section.

C. Duct Pressure Test:
   1. Written procedure for leak testing installed supply and exhaust ductwork system 14 days prior to testing.
   2. Duct pressure test report.

1.7 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Regulatory Agencies Requirements:
   1. All state and local codes, and ordinances.
   2. Owner's insurer.
   3. Flexible ductwork shall comply with:
      a. UL listed – Class 1 Air Duct Material, Standard 181.
      b. NFPA Standard 90A – Flame spread: 25, Smoke developed: 50.

1.8 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter and damage by weather or elements in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Duct Connection Systems:
   1. Ductmate Industries, Inc.
   2. Linx Industries.
   3. Lindab, Inc.

B. Flexible Duct:
   1. Casco Silent Flex – SF 181M.
   2. FLexmaster USA – Type 6M.
   3. JP Lamborn – AMF 07.

C. Prefabricated Fittings:
   1. United McGill Corporation.
   2. Buckley Air Products, Inc.
   3. Eastern Sheet Metal, Inc.
   4. LaPine Metal Products.
   5. Lindab, Inc.
   6. Ductmate Industries.
   7. Linx Industries.
   8. Semco.
   9. Universal Spiral Air.
   10. Allied Mechanical Services.
   11. Zinger Sheet Metal.

D. Manufactured ductwork and fittings shall be of one Manufacturer to ensure tight fit of ductwork and components.

E. Manufacturer's Stamp:
   1. Manufacturer's stamp shall be on the outside of the ductwork.
   2. Stamp shall be clean and clear, indicating the metal gage.

2.2 MATERIALS

A. Galvanized Steel:
   1. Galvanized steel of lock-forming quality with minimum ASTM A653, G90 zinc coating, both sides in accordance with ASTM A90.
   2. Use for all ductwork systems unless noted otherwise.

B. Acceptable Fasteners:
   1. Rivets, bolts, or sheet metal screws.
   2. Stainless steel.

C. Tapes:
   1. High pressure rated, non-hardening, water resistant and fire-resistant.
   2. Compatible with duct material.

D. Sealants:
   1. Fire and Smoke Hazard Rating:
      a. As tested by ASTM E84, NFPA 255, or UL 723.
      b. Not to exceed: Flame spread 25, smoke developed 50.
   2. Exterior Mastic Sealant: Certified to pass 600 hours QUV; or equivalent weather testing.
   3. Comply with ASTM C731 and D2202.
   4. Specifically formulated for sealing the field joints.
   5. UL listed.
   6. Hardcast, Inc. Sure Grip 404, Iron Grip 601, Flex Grip 550, Duct Seal 321.

7. Foster 32-19 Duct Fas, 32-17 Safetee, 32-14 High Velocity Duct Sealant.
8. Childer CP-146, Chil Flex C—147.

E. Hangers:
1. Galvanized steel band iron.
2. Rolled angle and 3/8-inch minimum galvanized steel rod.

F. Wall Supports:
1. Galvanized steel band iron.
2. Fabricated angle bracket.

G. Vertical Supports at Floors:
1. Rolled steel angle 1-1/2 x 1-1/2 x 1/8 minimum.
2. Mechanically attached to duct.

2.3 FABRICATION

A. General: Construct rectangular and round ductwork, and fittings in accordance with the SMACNA HVAC Duct Construction Standards, Metal and Flexible, current edition.

B. Round Ducts:
1. 60-inch Diameter and Smaller: Spiral lockseam construction.

C. Transitions: Make every change in size or shape of duct with taper not exceeding 20 degrees.

D. Connections:
1. Make connections to equipment as indicated on Drawings or called for by these Specifications.
2. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 2-inch on center.
3. Flexible Ductwork Connections:
   a. Securely fasten flexible duct to round sheet metal ducts or duct collars with stainless steel or zinc-coated iron draw bands with worm gear fastener.
   b. Flexible duct 10-inch diameter or less, installed on 1-inch W.G. pressure classification duct may be attached with nylon cable ties.
   c. Fabric shall not be stressed other than by air pressure.

E. Elbows and Tees:
1. Provide rectangular mitered elbows with acoustic turning vanes as indicated on the Drawings. Refer to Division 23 Section “Sound and Vibration Control for HVAC” for acoustic turning vanes.
2. Where mitered elbows are not indicated on the Drawings: Maintain centerline radius of 1-1/2 times duct width in plane of turn.

F. Turning Vanes and Distribution Devices: Where registers, grilles or diffusers are located less than 5 equivalent duct diameters from the main duct, provide necessary distribution grids or turning vanes to ensure even distribution of air over the entire face of the outlet.

G. Obstructions:
1. Wherever a pipe or other obstruction passes through a duct (this condition is to be avoided if possible), pass the obstacle through an airfoil sleeve in the duct.
2. Increase duct area at the obstruction if more than 20% of duct area is displaced by obstruction.
3. Streamline sleeve to maintain angles at duct size changes at 20 degree angle.

H. Provide necessary plastering frames and drawbands required.

I. Branch Ducts:
1. Construct with full radius elbow turning into a transition section in the main duct.
2. Provide with damper and quadrant as specified in Division 23 Section “Dampers.”

J. Paint grip finish for exposed ductwork in finished spaces.

2.4 MANUFACTURED UNITS

A. Turning Vanes:
1. Hem the leading edge of vanes in ducts over 20-inch width with 1/2-inch fold-back.
2. Reinforce turning vanes in ducts over 24-inch diameter with rods or sectional construction to limit unsupported length to 24 inches.
3. 24 gage, minimum.
4. Use in rectangular elbows with R/D ratio of less than 1.5.
5. Double wall.

B. Acoustic Turning Vanes: Refer to Division 23 Section “Sound and Vibration Control for HVAC.”

C. Takeoffs from Round 1-inch Pressure Classification Duct:
1. Made with factory fabricated lateral type fittings.
2. At an angle of no more than 45 degrees.
3. As manufactured by United McGill Corp., Model SRL; or approved equal.
4. In accordance with detail on Drawing.

D. Flexible Duct:
1. Acoustically lined.
2. Construction:
   a. Liner of laminated aluminum foil/fiberglass/aluminated polyester.
   b. Zinc-coated steel or Aluminum helix bonded to liner.
   c. Insulation R-value: 4.2.
   d. Seamless copolymer vapor barrier jacket.
   e. Rated for pressure class of system in which duct is used.
3. Flexible duct length shall be at least 3 feet but not exceed 5 feet, maximum flex duct turn not to exceed 45 degrees.

2.5 DUCT ACCESS DOORS

A. Manufacturers:
1. Prefco.
2. Pottorff.
3. Ventfabrics, “Ventlock.”
4. Greenheck.
5. Ductmate.
6. Linx Industries.

B. Provide In Ductwork:
1. As indicated on the Drawings.
2. Wherever necessary for proper access to instruments, controls, fire dampers, motorized dampers, coils and equipment.
3. For convenient inspection, maintenance and replacement.
4. Reinforce openings on sides with material or ductwork in which doors are installed.

C. Construction:
1. Two-piece 22 gage minimum pan construction, consisting of outer side crimped over inner dished side.
2. Continuous piano hinge and not less than 2 heavy cam latches. A removable type door is acceptable only where there is inadequate clearance for a hinged door.
3. Contact surfaces of doors covered with heavy dense felt securely fastened in place to make doors air tight.
4. Insulated or soundproofed with same materials as ducts or casings where located.
5. Ruskin ADH22 or ADC22; or equal.

2.6 SOURCE QUALITY CONTROL

A. Certified Testing:
   1. Suppliers of manufactured round and oval ductwork shall have on file with Engineer certified copies of test data made by an independent United States laboratory covering pipe and fittings as manufactured by that Supplier.
   2. Spiral Pipe Test Data:
      a. Cover leakage rate, bursting strength, collapsing strength, seam strength and friction loss.
      b. Friction loss test data shall cover both the duct and the assembled coupling joints.
      c. This friction loss data shall be equal to or less than the friction loss data used in the design of this system.
   3. The fitting test data shall cover the friction loss tests of all fittings used on the project.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install ductwork and accessories to provide a system free from buckling, warping, breathing, vibration, rattling, or whistling.
   2. Lap ducts in direction of air flow with longitudinal seams locked and hammered tight.
   3. Provide flat "S" cleats on all exposed traverse duct connections in finished areas.
   4. Install ducts straight with building walls where possible and exposed duct tight against roof or walls where possible.
   5. Ducts shall be air-tight, rigid, securely hung or bracketed in position.
   6. At the end of an uninsulated section or run, where internally insulated duct connects to uninsulated spiral duct or fitting, fire damper or flex, install an insulation end fitting to bring the outer shell down to nominal size.
   7. Install screws and rivets of such length that they do not interfere with the operation of manual or automatic dampers.
   8. Provide 1-inch long metal nosing around entire duct perimeter at all exposed and leading edges of internal acoustic ductwork lining.

B. Protection of System:
   1. Cap the ends of sheet metal ductwork, including the roof openings, registers and diffuser openings with temporary durable air-tight and water-tight covers during all stages of construction in order to keep system clean.
   2. If permanent heating and cooling equipment is used prior to Substantial Completion, protection of ductwork systems shall comply with Division 01 Section “Temporary Facilities and Controls.”

C. Hanging Duct:
   1. Allow swing in long direction of duct for movement.
   2. Double nut hanger rods.

D. Duct Anchoring:
   1. Galvanized sheet metal hanger straps attached to construction.
   2. Angle metal screwed to the ductwork.

E. Turning Vanes:
   1. Use in rectangular mitered elbows with R/D ratio of less than 1.5 and elsewhere as indicated.
   2. Install evenly spaced along elbow diagonal with leading and trailing edges aligned to sides of duct.
   3. Install vanes on 3-3/4-inch centers.
   4. Elbows Where Duct Changes Size:
      a. Mount vanes individually (not on premanufactured vane runners).
      b. Ensure that leading and trailing edges align parallel to sides of duct.

F. Exterior Ductwork: Refer to SMACNA Guidelines specified in Paragraph 1.3.A.5.a, Pages 5-6, 5-7, and 5-8 for requirements of construction and installation.

G. Joint Sealing of Duct Systems:
   1. Except where using gasketed duct connection systems, seal ductwork in accordance with SMACNA Class A:
      a. Seal ductwork including supply, return, mixed, outdoor, and exhaust air systems.
      b. For Round and Flat Oval Ductwork:
         1) Apply approved sealant to the male end of the couplings and fittings.
         2) After the joint is slipped together, place sheet metal screws 1/2-inch from the joint bead for mechanical strength.
         3) Apply sealer to the outside of joints including longitudinal joints, extending 1-inch on each side of the joint.
         4) Cover screw heads.
      c. For Rectangular Ductwork:
         1) Apply approved sealant to transverse and longitudinal joints.
         2) Extend sealant a minimum of 1-inch on each side of joint.
      d. Follow sealant Manufacturer's directions for application, storage and cure time.
      e. Ductwork located outside shall be air and watertight.
      f. Aluminum Ducts: Seal seams and joints watertight. Pitch ducts to low points and drain low points in the system.
      g. Stainless Steel Ducts for Dishwasher Exhaust: Seal seams and joints watertight. Pitch ducts to low points and drain low points in the system.
   2. Manufactured Connection Systems:
      a. Acceptable in accordance with Paragraph 2.1.
      b. Seal flanged joints with neoprene gaskets.

H. Appearance: Where exposed ducts pass through walls or floors: Refer to Division 23 Section "Penetrations for HVAC."

3.2 SEALING AROUND LOW AND HIGH PRESSURE DUCT OPENINGS

A. The openings around ducts that penetrate full height walls (defined as walls that extend from the floor to the structure above): Seal to maintain the acoustic integrity of the wall. This applies to all full height walls regardless of whether the wall has a fire rating.

B. Gaps:
   1. Less Than 1/2-inch Between Duct and Wall Opening: Pack with batt insulation and the exposure caulked on both sides of the wall.
   2. Gaps 1/2-inch and Larger Between Duct and Wall Opening: Pack with batt insulation and a sheet metal collar installed around the entire duct on both sides of the wall. Extend the sheet metal collar from the surface of the duct to a minimum 2 inches on the wall, and be secure to the wall.

3.3 HANGING AND SUPPORT

A. All Ducts:
   1. Support in a secure manner.
   2. Subject to Engineer's approval.

B. In accordance with Chapters 5 and 6 of the SMACNA HVAC Duct Construction Standards.

C. Do not support ductwork from metal roof deck.

D. Remove and replace unacceptable work at no additional cost to Owner.

3.4 FIELD QUALITY CONTROL

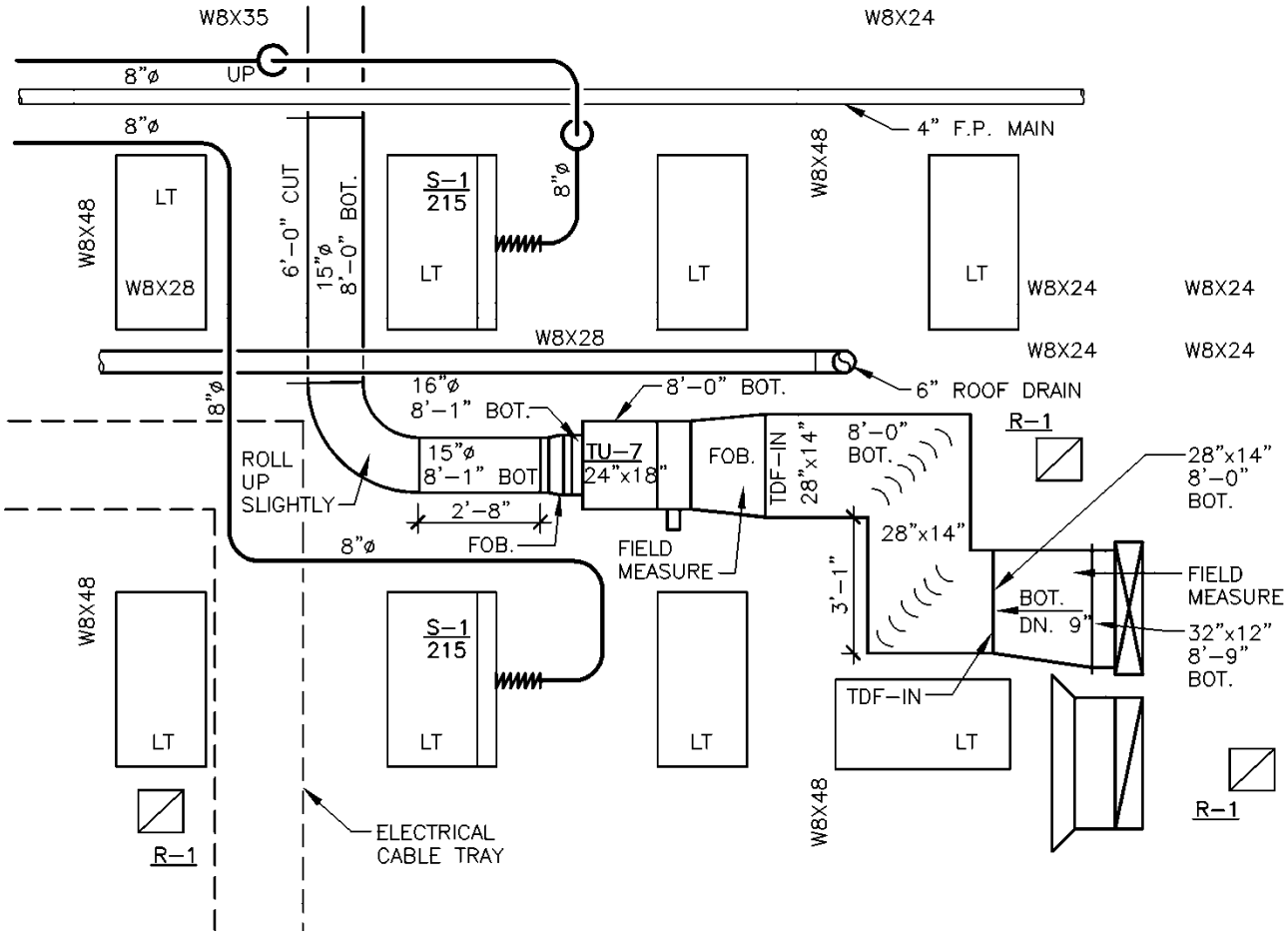
A. Duct Systems to be Tested:
   1. Supply ducts. Supply ducts upstream of VAV boxes.
   2. Exhaust ducts.

B. Pressure Testing:
   1. Pressurize the installed duct system to a test pressure equal to the designated SMACNA pressure classification:
      a. Duct systems to be tested under their design pressures.
         1) Positive pressure for supply ducts.
         2) Negative pressure for exhaust, return, OA, etc.
   2. Measure air leakage at the test pressure by an orifice type of flow meter which has been individually calibrated against a primary standard and this calibrated curve permanently attached to the orifice tube assembly.
   3. If the system is tested in sections, add the leakage rates to give the performance of the whole system.
   4. Total allowable leakage of the system shall not exceed 3.0 of the associated system design total air flow CFM.
   5. Correct Objectionable Noise:
      a. Even if the system passes the leakage rate criteria.
      b. To the satisfaction of Engineer.

C. Perform testing in accordance with a printed procedure reviewed by Engineer.

D. Notify Engineer 1 week prior to duct pressure test to allow Engineer the option to be available to observe testing.

E. Pressurization Control:
   1. Protection against duct overpressurization and underpressurization during testing is the responsibility of Contractor.



END OF SECTION 23 31 13

SECTION 23 33 13 – DAMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes, but is not limited to, the major items listed below:
   1. Airflow regulating dampers.
   2. Control dampers.

B. Division of Work:
   1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the Work to be performed by specific trades.
   2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the Work:
      a. Mechanical Subcontractor:
         1) Install control dampers.
         2) Provide manual dampers and gravity backdraft dampers.
      b. Temperature Control Subcontractor:
         1) Furnish control dampers, linkages and operators unless specifically noted otherwise on Drawings.
         2) Install linkages and operators on dampers.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with the following:
   1. NFPA 90A – Air Conditioning and Ventilating Systems.
   2. SMACNA Publications:
      a. Fire, Smoke and Radiation Damper Installation Guide for HVAC systems.
      b. HVAC Duct Construction Standards – Metal and Flexible.
   3. ASTM:
      a. E84 – Test for Surface Burning Characteristics of Building Materials.
      b. E477 – Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
   4. UL:
      a. 555 – Fire Dampers.
      b. 555C – Ceiling Dampers.
      c. 555S – Leakage Rated Dampers for Use in Smoke Control Systems.
   5. ASHRAE: 90.1 – 2019 Energy Efficient Design of New Buildings Except Low Rise Residential Buildings, with state amendments.

1.4 SUBMITTALS

A. Manufacturer's Literature:
   1. Submit For:
      a. Airflow regulating dampers.
      b. Duct access doors and panels.
      c. Control dampers.
   2. Required Information:
      a. General:
         1) Dimensions.
         2) Details of construction and installation.

3) Name of Manufacturer.
4) Model.

b. Control Damper:
1) Air pressure drop.
2) Leakage rate.
3) Performance data as tested in accordance with AMCA Standards.

B. Operation and Maintenance Manuals: For each type of VAV damper.
1. Equipment function, normal operating characteristics and limiting conditions.
2. Assembly, installation, alignment, adjustment and checking instructions.
3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
4. Lubrication and maintenance instructions.
5. Guide to “troubleshooting.”

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Regulatory Agencies Requirements:
1. UL:
a. Fire dampers shall conform to UL 555 and bear the UL label.
b. Radiation dampers shall conform to UL 555C and bear the UL label.
c. Smoke dampers shall conform to UL 555S and bear the UL label.
2. Installation and materials shall be in accordance with:
a. All state and local codes and ordinances.
b. Owner's insurer.

1.6 SEQUENCING AND SCHEDULING

A. Installation of control components at the Manufacturer’s factory or in the field is optional only to the extent that schedule is not adversely affected.

PART 2 - PRODUCTS

2.1 AIRFLOW REGULATING DAMPERS

A. Manufacturers:
1. Dampers:
a. American Warming and Ventilating, Inc.
b. Ruskin.
c. Louvers and Dampers, Inc.
d. Greenheck.
e. Pottorff.
f. Nailor.
2. Regulators:
a. Duro-Dyne.
b. Ventlok.

B. Provide accessible, manually operable dampers:
1. At branch duct take-offs.
2. At diffuser run-out take-offs.
3. Downstream of duct coils.
4. As indicated on the Drawings by the manual balancing damper or "B.D." symbol.

C. Dampers for Round Duct:
   1. For 8-inch and smaller, premanufactured dampers equal to Pottorff CD-10R. Provide quadrant standard bracket for insulated ductwork, coordinate with required insulation thickness on specified duct system.
   2. Field Fabricate Dampers:
      a. Blade:
         1) Galvanized steel.
         2) Two gages heavier than duct in which installed.
      b. Pivot rod continuous, 3/8-inch minimum for 12 inches and larger, 1/4-inch for under 12-inch size.
      c. Hardware:
         1) For dampers less than 12 inches round, provide a dial regulator set consisting of 1 dial regulator, 1 square end bearing and 1 spring end bearing; equal to Durodyne Set No. KS-145 or KS145L.
         2) For dampers larger than 10 inches round, provide a dial regulator set consisting of 1 dial regulator, 1 square end bearing and 1 spring end bearing equal to Durodyne Set No. KSR-195 or KSR-195L.

D. Dampers for Rectangular Duct:
   1. Field Fabricate Single Blade Dampers:
      a. Blade:
         1) Galvanized steel.
         2) Two gages heavier than duct in which installed.
         3) 12-inch maximum height.
      b. Pivot Rod:
         1) 3/8-inch pins up to 18-inch wide.
         2) 1/2-inch continuous rod over 18-inch wide.
   2. Dampers with Vertical Dimension Over 12 Inches:
      a. Use opposed blade type.
      b. Blade:
         1) 18-gage minimum galvanized steel.
         2) 12-inch maximum blade height.
         3) Hardware.

E. Regulator:
   1. Quadrant type with handle and wingnut.
   2. Provide with integral insulation flange or standoff for installations on insulated ductwork.
   3. Provide end bearing.
   4. Equal to Duro Dyneset KS-12.

F. Remote Controlled Dampers and Operators:
   1. Manually operated and mechanically linked damper regulator; equal to Ventlok #677 with plain cover, Ventlok #695 and #696 universal joints and Ventlok #601 joints and square rod.

   2. Manual Balancing Damper:
      a. Equal to Ruskin model ZPD15 or Pottorff model RD-10.
      b. Damper constructed with galvanized steel frame, 20 gage galvanized steel blade, 3/8-inch square axle shaft, synthetic or Lexan bearings, maximum static pressure of 2 inches, maximum velocity of 2,000 fpm.
      c. With 9-volt powered gear drive actuator with optional remote damper control (1 required), wall box with cover plate and interconnecting cable.

G. Dampers Upstream of Coils: Opposed blade type.

2.2 GRAVITY BACKDRAFT DAMPER

A. Manufacturer:
   1. American Warming & Ventilation, Inc.
   2. Pottorff
   3. Louvers & Dampers, Inc.
   4. Ruskin.
   5. Greenheck.

B. General Requirements:
   1. 0.070-inch extruded aluminum blades.
   2. 0.125-inch extruded aluminum frame.
   3. Adjustable counterbalanced blades.
   4. Mill finish.
   5. Low leakage.
   6. Operable down to 0.02-inch WG.
   7. Based on Ruskin Model CBD-6 or Pottorff CBD-250.

2.3 AUTOMATIC CONTROL DAMPERS

A. Manufacturer:
   1. Ruskin.
   2. Greenheck.
   3. Pottorff.
   4. Louvers & Dampers, Inc.
   5. Johnson.
   6. Honeywell.
   7. Nailor.

B. General:
   1. Provide single, multiple, parallel, or opposed blade as required.
   2. Parallel blade design for mixing applications, opposed blade for throttling application.
   3. Orient mixing dampers to converge the 2 airstreams.
   4. Provide opposed blade dampers for 2-position applications, except where noted otherwise.
   5. Where not indicated on the Drawings, damper construction shall be as follows:
      a. Use standard dampers (as described below) for all applications, except as follows.
      b. Use low leakage dampers whenever damper is used to isolate outside or contaminated air from a ducted airstream or air handling unit or wherever velocity exceeds 1500 fpm.
      c. Use low leakage insulating dampers wherever damper is used to isolate outside or contaminated air directly from an occupied space or plenum (unducted).
      d. When an economizer is required, use low leakage dampers wherever damper is used to isolate outside, exhaust, relief, return or contaminated air from a ducted airstream or air handling unit.

C. Standard Construction:
   1. Construct damper frames of minimum 16 gage galvanized sheet metal, with flanges for duct mounting with corner brackets to provide rigid frame.
   2. Damper blades shall not exceed 6 inches in width.
   3. Blades shall be galvanized steel with 1/2-inch minimum 16 gage plated tube or solid axle keyed into 12-gage pivot arms.
   4. The bearings shall be synthetic sleeve type.
   5. Blade Sealing:
      a. Provide silicone, TPV, neoprene or PVC coated fabric seals.
      b. Install seals along the top, bottom and sides of the frame and along each blade edge.
      c. Seal shall provide a tight closing low leakage damper.
      d. Leakage shall not exceed 11 CFM/SF at 4-inch W.G. for a 24-inch x 24-inch damper.
      e. Provide flexible stainless steel jamb seal.
   6. Damper blade interlock linkages shall drive the shaft of each blade, not the blade edge.
   7. Ruskin Model CD36, Pottorff CD-41/42; or equal.

D. Low Leakage Construction:
   1. Construct damper frames of minimum 14 gage galvanized sheet metal, with flanges for duct mounting with corner brackets to provide rigid frame.
   2. Damper blades shall not exceed 6 inches in width.
   3. Blades shall be airfoil shaped of extruded aluminum double wall with 1/2-inch minimum 16 gage plated tube or solid axle keyed into 12-gage pivot arms.
   4. The bearings shall be synthetic sleeve type.

5. Blade Sealing:
    a. Provide mechanically fastened or replaceable TPV, PVC, rubber or neoprene seals.
    b. Install seals along the top, bottom and sides of the frame and along each blade edge.
    c. Seal shall provide a tight closing low leakage damper.
    d. Leakage shall not exceed 8 CFM/SF at 4-inch W.G. for a 24-inch x 24-inch damper.
    e. Provide flexible stainless steel jamb seal.
6. Damper blade interlock linkages shall drive the shaft of each blade, not the blade edge.
7. Ruskin Model CD50; or Pottorff CD-51/52; or equal.

E. Low Leakage Construction – Insulating:
1. Construct damper frames of minimum 0.125-inch extruded aluminum, with flanges for duct mounting with corner brackets to provide rigid frame.
2. Damper blades shall not exceed 6 inches in width.
3. Blades shall be airfoil shaped of extruded aluminum double wall insulated with 1/2-inch minimum 16 gage plated tube or solid axle keyed into 12-gage pivot arms.
4. The bearings shall be synthetic sleeve type.
5. Blade Sealing:
    a. Provide mechanically fastened or replaceable TPV, PVC, rubber or neoprene seals.
    b. Install seals along the top, bottom and sides of the frame and along each blade edge.
    c. Seal shall provide a tight closing low leakage damper.
    d. Leakage shall not exceed 8 CFM/SF at 4-inch W.G. for a 24-inch x 24-inch damper.
    e. Provide Silicone or Neoprene jamb seal.
    f. Submittal performance data must be for complete assembly.
6. Damper blade interlock linkages shall drive the shaft of each blade, not the blade edge.
7. Ruskin Model TED50, Pottorff Model TICD-51/52; or equal.

F. Damper Operators: Furnish in accordance with the requirements of Division 23 Section “Instrumentation and Control for HVAC.”

2.4 INSTRUMENT TEST HOLES

A. Manufacturer: Ventlock Model 699; or equal.

B. Provide at control points including but not necessarily limited to:
1. Air temperature controller sensors.
2. Pressure sensors.
3. Temperature limit devices.
4. Locations determined by Test and Balance Engineers.

C. Compatible with duct external insulation thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install duct accessories in conformance with:
    a. The Shop Drawings reviewed by Engineer.
    b. SMACNA HVAC Duct Construction Standards and Fire, Smoke and Radiation Damper Installation Guide.
    c. These specifications where different from SMACNA.
    d. Manufacturer's written instructions.
2. Locate branch dampers used for air flow regulation as close as possible to main trunks.
3. Dampers shall not rattle or generate airborne noise of any kind regardless of damper position.
4. Dampers located upstream of coils shall not interfere with uniform velocity profile at coil face.
5. Locate and orient duct accessories according to Manufacturer's instructions relative to nearby fittings, elbows, and fans.
6. Verify that dampers move freely through their entire stroke without binding.

B. Access:
   1. Concealed duct accessories requiring inspection, service or maintenance shall be accessible.
   2. Provide acceptable means of access.
   3. Ensure that damper operator handles are not covered by insulation.

END OF SECTION 23 33 13

SECTION 23 34 23 – HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of power ventilators.

B. Fans furnished as part of the air handling units are specified elsewhere.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. AMCA (Air Movement and Control Association) Standards:
      a. 99 – Fabrication Standards.
      b. 210 – Laboratory Method for Testing Fans for Aerodynamic Performance Rating.
      c. 261 – Directory of Products Licensed to Use the AMCA Certified Ratings Seal.
      d. 300 – Reverberant Room Method for Sound Testing of Fans.
   2. UL:
      a. 705 – Power Ventilators.
      b. 762 – Power Roof Ventilators for Restaurant Exhaust Appliances.
   3. NFPA:
      a. 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
   4. ASHRAE: 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, with state amendments.

1.4 SYSTEM DESCRIPTION

A. All power ventilators shall be selected as indicated on the Drawings:
   1. Airflow and static pressure indicated are minimums.
   2. Fan speed, brake horsepower (BHP) and sound ratings are maximum.

B. Manufacturer name and model number information given in equipment schedules represent quality and performance standards for that equipment.

C. Unless stated otherwise, fans shall be provided with the following:
   1. Compatible curb or mounting hardware.
   2. Factory installed disconnect switch.
   3. Bird screen.

1.5 SUBMITTALS

A. Shop Drawings: For exhaust fans.
   1. Dimensions.
   2. Details of construction and installation.
   3. Name of Manufacturer.
   4. Model.
   5. Fan identity by equipment schedule Tag No.
   6. Fan curve with selection point clearly indicated for CFM, total static pressure, BHP and RPM.
   7. Electrical characteristics and project specific wiring diagrams including control wiring.
   8. Fan sound power level in sones at rated capacity.

B. Operation and Maintenance Manuals: For exhaust fans.
   1. Equipment function, normal operating characteristics and limiting conditions.
   2. Assembly, installation, alignment, adjustment and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   4. Lubrication and maintenance instructions.
   5. Guide to "troubleshooting."
   6. Parts lists and predicted life of parts subject to wear.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Regulatory Agencies Requirements:
   1. All state and local codes and ordinances.
   2. Owner's insurer.

C. Quality Assurance:
   1. AMCA ratings program certified and bearing AMCA air and sound seals.
   2. UL listed electrical components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All power ventilators, except as indicated herein:
   1. Greenheck.
   2. Cook.
   3. Penn Barry.
   4. Aerovent.
   5. Acme.

B. Electronically Commutated Motor: Motor shall be an electronic commutation (EC) motor specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds
   1. Provide with factory mounted and wired speed control:
   2. Motor and drive shall be accessible without disturbing ductwork.
   3. Motor shall be out of air stream.
   4. Motor Cover:
      a. Constructed of galvanized steel
      b. Covers motor and drives for safety
      c. Standard on unit specified with UL

2.2 GENERAL REQUIREMENTS

A. The equipment shall be factory built and factory tested.

B. The Manufacturer shall repair or replace any items which fail to obtain specified performance.

C. All fans shall be statically and dynamically balanced and tested.

2.3 DOMED CENTRIFUGAL ROOF VENTILATOR

A. Housing:
   1. Low silhouette, weatherproof, heavy gage spun aluminum housing, self-supporting, enclosing venturi-orifice and fan inlet and wheel and overlapping fan curb.
   2. With rain and snow weather guard.
   3. Baked enamel finish, color as selected by Engineer.
   4. Aluminum bird screen in discharge outlet.

B. Fan Wheel:
   1. All aluminum key locked to drive shaft, backward inclined, quiet nonoverlapping centrifugal fan wheel statically and dynamically balanced.
   2. Permanently lubricated fan bearing.

C. Motor and Drive:
   1. Comply with the requirements of Division 23 Section “Common Motor Requirements for HVAC Equipment.”
   2. Resilient mounted outside of air stream, inside weatherproof housing.
   3. Disconnect switch mounted inside housing, with factory wiring to motor.
   4. Electronically Commutated Motor: Motor shall be an electronic commutation (EC) motor specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds
   5. Provide with factory mounted and wired speed control:
   6. Motor and drive shall be accessible without disturbing ductwork.
   7. Motor shall be out of air stream.
   8. Motor Cover:
      a. Constructed of galvanized steel
      b. Covers motor and drives for safety
      c. Standard on unit specified with UL

D. Roof Curb: Comply with the requirements of Division 23 Section “Penetrations for HVAC.”

E. Dampers: Refer to Division 23 Section “Dampers.”

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. Verify that openings and adjacent areas are free of obstructions, and ready to receive fans.

B. Begin installation of fans only when openings conform to Specification requirements.

C. Install fan(s) and accessories in accordance with Manufacturer's instructions.

D. Secure components to openings and to each other.

E. Adjust fan, belts and components as necessary for:
   1. Smooth operation.
   2. Proper running amperage.
   3. Minimum vibration.

F. Replace components found out of alignment and balance.

END OF SECTION 23 34 23

SECTION 23 36 00 – AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all variable air volume (VAV) terminal units.

B. Cash Allowances: Work listed below to be completed by the temperature control system (T.C.S.) Subcontractor will be paid for from a cash allowance as specified in Division 01 Section “Cash Allowances” and performed by a T.C.S. contractor selected by Engineer.

C. Division of Work:
1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.
2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   a. General Contractor:
      1) Install access hatches for terminal units:
         a) As directed by Mechanical Subcontractor.
         b) As specified in Division 08 Section “Access Doors and Panels.”
   b. Mechanical Subcontractor:
      1) Furnish all access doors:
         a) As required for access to concealed terminal units.
         b) In accordance with Division 08 Section “Access Doors and Panels.”
      2) Coordinate with General Contractor for access hatch locations and installation.
      3) Furnish and install VAV terminal units in ductwork system and provide hangers and support.
   c. Temperature Control Subcontractor:
      1) Provide control components:
         a) Furnish to VAV terminal unit Manufacturer.
         b) Complete field installation and calibrate.

1.3 SYSTEM DESCRIPTION

A. General:
1. The assemblies shall be pressure independent.
2. Units shall be capable of morning warm-up operating control sequence.

B. Design and Performance Requirements:
1. Air leakage less than 2% at 0.5 inches w.c. static pressure.
2. Space NC less than 35 at 2000 fpm inlet velocity.

1.4 SUBMITTALS

A. Shop Drawings: For all terminal units.
1. General:
   a. Dimensions.
   b. Details of construction and installation.
   c. Name of Manufacturer.
   d. Model.

2. For Each Unit:
   a. Identify by schedule Tag No.
   b. Air pressure drop at maximum position for specified airflow.
   c. Acoustic data at specified maximum and minimum airflows.
   d. Coil performance data.

B. Operation and Maintenance Manuals: For each type of VAV terminal unit.
   1. Equipment function, normal operating characteristics and limiting conditions.
   2. Assembly, installation, alignment, adjustment and checking instructions.
   3. Operating instructions for startup, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   4. Lubrication and maintenance instructions.
   5. Guide to "troubleshooting".
   6. Parts lists and predicted life of parts subject to wear.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.
   3. A

B. Air terminal units shall be tested and rated in accordance with AHRI Standard 880.
   1. Manufacturer shall be a participant in the AHRI Air Terminal Unit Certification Program.

C. Regulatory Agencies Requirements:
   1. The entire unit including heating coils shall be UL listed and labeled.
   2. All insulation in accordance with:
      a. UL 181 for erosion.
      b. NFPA 90A for fire and smoke.
   3. Installation shall comply with:
      a. All state and local codes and ordinances.
      b. Owner's insurer.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with sheet metal Subcontractor for scheduling of terminal unit installation so as to not delay the job.

B. Installation of control components at the Manufacturer's factory or in the field is optional only to the extent that schedule is not adversely affected.

1.7 WARRANTY

A. Warranty shall cover all component parts for a period:
   1. Not less than 36 months.
   2. Beginning from date of shipment.

B. Manufacturer shall bear all costs:
   1. For establishing and defining cause of unit's failure to perform as specified.
   2. For correcting or replacing all nonperforming units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Titus.

B. Carrier.

C. Price.

D. Trane.

E. Nailor.

F. Kreuger.

2.2 MANUFACTURED UNITS

A. Casing:
1. Minimum 22 gage galvanized steel.
2. Internally Lined:
a. Comply with the requirements of Division 23 Section “Duct Insulation” for internal lining material.
b. 1 -inch glass fiber.
c. Minimum 4 pound per cubic foot density.
d. Mat faced or mylar lined.
e. All exposed edges shall receive the manufacturer's standard treatment to prevent erosion, delamination, and fiber release..
3. Full bottom access door.

B. Damper:
1. Manufacturer's standard pressure-independent airflow control assembly.
2. Damper shall provide stable airflow control throughout the scheduled operating range.
3. Damper and airflow measuring device shall be factory assembled and calibrated.

2.3 COMPONENTS

A. Terminal Control Components – Electronic:
1. Airflow Sensor and Transducer:
a. Factory installed airflow measuring device integral to the terminal unit.
b. Device shall provide airflow measurement accuracy within ±5 percent of indicated airflow over the specified operating range.
c. Integral flow taps and a calibration chart shall be provided with each unit.
2. Terminal Damper Actuator – Electronic:
a. Direct coupled actuator used to control the primary air damper of the terminal control unit.
b. Constant current and torque limiting.
c. The actuator shall be factory mounted, wired and installed by the terminal unit Manufacturer.
d. Fully compatible with the electronic control signal for the T.C.S.
e. Actuator shall be sized by the manufacturer for the required control authority and operating conditions.
f. Capable of going from full open to full closed (or vice versa) in a maximum of 60 seconds.
3. Terminal Box Controller Module:
a. Refer to Division 23 Section “Instrumentation and Control for HVAC” for controller module requirements.
b. Controller shall be fully compatible with the building automation system.
c. Each BACnet device shall be BTL listed.

2.4 ACCESSORIES

A. Multiple Outlet Plenum:
   1. Provide internally lined plenum with multiple outlets as indicated on the Drawings.
   2. Each outlet is to include a locking butterfly balancing damper.

A. Hot Water Coils:
   1. General:
      a. Extended surface type.
      b. Constructed of copper tubing.
      c. Plate fins of copper or aluminum extending at right angles to the tubes.
      d. All coils to be drainable type.
   2. Tubes:
      a. Pressure bonded into the fin collars by expanding the tubes; no solder bonding shall be used.
      b. Material: Copper or red brass.
      c. Where the water velocity in the tubes is below 4 feet per second, and additional capacity is required, smooth brass spiral turbulators shall be furnished to ensure turbulent water flow and thereby increase the heat transfer performance. Turbulators shall not be furnished if the water velocity exceeds 4 feet per second.
   3. Fins:
      a. Full fin collars for maximum fin tube contact and accurate spacing and mechanically bonded to tubes for permanent fin tube bond.
      b. Material: Plate type aluminum or copper.
      c. There shall be a minimum of 6 fins per inch of pipe.
   4. Casings: 16 gage galvanized steel.
   5. Design Conditions:
      a. As indicated on Drawings.
      b. Minimum Rating:
         1) 250 psig or 1.5 times system pressure.
         2) 400 degrees F for hot water coils; 220 degrees F for chilled water coils.

B. VAV Attenuator:
   1. Manufacturer provided integral VAV attenuator similar to Titus DESVQ.

2.5 TERMINAL CONTROL UNIT POWER REQUIREMENTS

A. All air terminal units shall be designed for single point power connections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. As indicated on the Drawings.

B. In accordance with Manufacturer's installation instructions.

END OF SECTION 23 36 00

SECTION 23 37 00 – AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all air inlet and outlet devices.

B. Division of Work:
1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.
2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   a. General Contractor: Install stationary and adjustable louvers specified herein.
   b. Mechanical Subcontractor:
      1) Furnish stationary and adjustable louvers specified herein.
      2) Coordinate with General Contractor for proper louver installation.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
1. AMCA Publications:
   a. Standard 500 – Laboratory Methods of Testing Louvers for Rating.
   b. Standard 511 – Certified Ratings Program for Air Control Devices.

1.4 SUBMITTALS

A. Manufacturer's Literature: For all items specified herein.
1. General:
   a. Dimensions.
   b. Details of construction and installation.
   c. Name of Manufacturer.
   d. Model.
2. Performance at Scheduled Airflow:
   a. Maximum supply outlet throw value based on 50 fpm terminal velocity.
   b. Maximum air pressure drop in inches water gage.
   c. Maximum noise criteria (NC) level.
3. Louvers:
   a. Performance Ratings:
      1) AMCA Certified.
      2) For Engineer’s approval prior to fabrication.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed Shop Drawings.

PART 2 - PRODUCTS

2.1 REGISTERS, GRILLES, DIFFUSERS

A. Manufacturers:
   1. Titus.
   2. Nailor.
   3. Price.

B. General Construction Features:
   1. Refer to the Drawings for styles, types and design and materials.
   2. Return registers and grilles shall have fixed fins.
   3. Provide opposed blade, key operated dampers with registers.
   4. Provide remote operated dampers with registers as indicated on the drawings.
   5. Provide sponge rubber gaskets at mounting flanges.
   6. Linear slot diffuser plenums with 1/2-inch glass fiber material treated for surface erosion.
   7. Frame:
      a. Provide factory manufactured frame to allow proper mounting to surface in which installed, i.e., plaster, concrete, T-bar, splined ceiling, etc.
      b. Coordinate each case with architectural Drawings.

C. Finish:
   1. Manufacturer's standard paint ; color selected by Engineer. See schedule for color information.
   2. Anodized acceptable where standard for specific item.
   3. Off-white color for suspended ceiling installations, except where noted as black.

D. Accessories:
   1. Provide where indicated or required.
      a. Equalizing grid.
      b. Neck mounted damper.
      c. Remote damper.

E. Manufacturer/model numbers are scheduled on Drawings to indicate performance criteria, appearance style and quality of materials.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow Manufacturer's instructions, subject to Engineer's approval.

B. Install registers, grilles and diffusers only after finish painting has been completed.

C. Install fixed vane return and exhaust grilles with angle of vanes perpendicular to normal line-of-sight.

D. Locate outdoor air intakes a minimum of 10'-0" from plumbing and gas fired appliance vents and exhaust fan discharges.

3.2 ADJUSTING

A. Set pattern controllers on slot diffusers and set vanes on adjustable diffusers to provide air flow patterns as indicated on the Drawings.

3.3 PAINTING

A. Unlined Ductwork:
   1. Where visible behind registers, grilles and diffusers.
   2. Apply flat black paint:
      a. 2 coats.

END OF SECTION 23 37 00

SECTION 23 52 16 – CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fully modulating, gas-fired, condensing hot water boilers intended for wall-mounted commercial heating applications.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASME (American Society of Mechanical Engineers):
      a. Boiler and Pressure Vessel Code Part IV.
      b. CSD-1 – Controls and Safety Devices for Automatically Fired Boilers.
   2. NEMA (National Electric Manufacturer's Association):
      a. 250 – Enclosures for Electrical Equipment.
   3. NFPA 54 – National Fuel Gas Code.
   4. UL – Underwriters Laboratories:
      a. 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors.
      b. 486B – Wire Connectors for Use with Aluminum Conductors.
   5. ASHRAE 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, with state amendments.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Boiler System:
   1. Provide access for inspection, service, and maintenance in accordance with the boiler manufacturer's recommendations.

B. Performance and Capacities:
   1. Refer to Schedule on the Drawings.
   2. Thermal efficiency, net IBR output, and water volume listed are the minimum acceptable.

1.5 SUBMITTALS

A. Shop Drawings:
   1. Dimensions.
   2. Details of construction and installation.

B. Manufacturer's Data:
   1. Name of Manufacturer.
   2. Model.
   3. List of boiler trim and furnished accessories.
   4. Performance Data:
      a. Input and output ratings.
      b. Efficiency.
      c. Data at scheduled operating conditions.
   5. Project specific wiring diagrams including controls wiring.

C. Operation and Maintenance Manuals:
   1. Equipment function, normal operating characteristics and limiting conditions.
   2. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   3. Lubrication and maintenance instructions.
   4. Guide to "troubleshooting".
   5. Parts lists and predicted life of parts subject to wear.
   6. Outline, cross-sections, assembly drawings, engineering data and wiring diagrams.
   7. Test data and performance curves.

D. Start-Up Report: Written report and certification from factory authorized representative of installation and start-up approval.

E. Inspection Certificate:
   1. Arrange and pay for all inspections, certifications, and permits required by the Authority Having Jurisdiction, including initial operating permit inspection.
   2. Submit to Engineer.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Manufacturer's Field Services:
   1. Manufacturer's personnel trained in field installation supervision and employed by the Manufacturer in this work for 6 months, minimum.
   2. Verify installation.
   3. Supervise and direct start-up.
   4. Instruct Owner's personnel in operation and maintenance procedures.
   5. Coordinate manufacturer’s water quality requirements with water treatment provider.
   6. Not to exceed 2 days.

C. Regulatory Agencies Requirements:
   1. ASME Boiler Code – stamped on unit.
   2. UL listed and labeled.
   3. Comply with all state and local Codes and ordinances.
   4. Comply with OSHA and MIOSHA.
   5. Comply with Owner's insurer.
   6. ASME CSD-1.
   7. IBR:
      a. Tested and rated in accordance with “Testing and Rating Standard for Heating Boilers.”
      b. Bearing IBR emblem on nameplate.

D. Electrical Components, Devices and Accessories: Boilers must be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. I=B=R® Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.

F. ASME Compliance: Condensing boilers must be constructed in accordance with ASME Boiler and Pressure Vessel Code, Section IV “Heating Boilers.”

G. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers – Minimum Efficiency Requirements."

H. UL Compliance: Boilers must be tested for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to Authorities Having Jurisdiction.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which Manufacturer agrees to repair or replace heat exchangers damaged by thermal shock or that fail in materials or workmanship within specified warranty period.

B. Warranty Period for Heat Exchangers: 10 years from date of Substantial Completion.

C. Parts Warranty: Minimum 2 years from date of Substantial Completion.

D. Warranty shall remain in effect provided the installed system water quality is maintained in accordance with the boiler manufacturer's published requirements.

E. Contractor shall submit manufacturer's water quality requirements as part of the closeout documents.

PART 2 - PRODUCTS

2.1 GENERAL

A. The hot water heating boiler shall be a high-efficiency gas-fired condensing boiler.

B. Flue gas condensation collection shall be extracted using a corrosion-resistant stainless steel alloy heat exchanger.

C. Construction:
1. The combustion chamber, heat exchanger and condensate collector shall be constructed of high-alloy stainless steel.
2. The heat exchanger shall be fully accessible, using a full-swing door, or easily removable panel, to allow for easy inspection and cleaning.

2.2 CONDENSING HOT WATER BOILERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lochinvar.
2. AERCO International, Inc.
3. Thermal Solutions.
4. Raypak.
5. RBI.
6. NTI.
7. Approved equal.

B. Description:
1. factory-fabricated, factory-assembled, and factory-tested, fully modulating, gas-fired, condensing hot water boiler intended for wall-mounted commercial heating applications.
2. Boiler shall be provided complete with heat exchanger, combustion system, controls, safety devices, vent and
3. combustion-air connections, water connections, condensate drain connection, and factory-installed gas train.

C. Heat Exchanger:
1. Stainless steel construction.
2. All surfaces exposed to condensate or combustion products shall be corrosion resistant.

D. Combustion System:
   1. Factory-packaged premix burner with forced-draft blower.
   2. Burner shall be capable of fully modulating operation.

E. Turndown: Minimum 10:1 turndown ratio per boiler.

F. Ignition: Electronic direct spark or hot-surface ignition with flame supervision and 100 percent safety shutoff.

G. Gas Train: Factory assembled, factory wired, and factory tested gas train listed as part of the boiler assembly.

H. Jacket:

I. Factory-finished steel enclosure with removable service panels.

J. Combustion-Air and Vent Connections: Provide intake and vent connections suitable for sealed combustion operation.

K. Efficiency:

L. Minimum thermal efficiency as scheduled on the Drawings and in compliance with ASHRAE 90.1.

2.3 CONTROLS

A. Each boiler shall include factory mounted controls capable of:
   1. Modulation of firing rate.
   2. Outdoor air reset.
   3. Supply water temperature control.
   4. High limit protection.
   5. Low water cutoff protection.
   6. Freeze protection.
   7. Pump control.
   8. Lead-lag sequencing.
   9. Runtime equalization.
   10. BACnet IP or BACnet MS/TP communications.

2.4 FITTINGS AND TRIM

A. Include devices sized to comply with ASME B31.9.

B. Factory-Mounted Controls: Operating control, modulating control, and manual-reset high-limit safety control.

C. Safety Relief Valve: ASME rated 30 psi.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is approximately 50% of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS 3/4 hose-end drain valve.

G. Furnish, install and wire the following on boiler where applicable:
   1. Combination thermometer and pressure gage.
   2. ASME Code rated boiler relief valve set at 30 psig.
   3. Low water cut-off.

H. Condensate Neutralization:
   1. Provide a condensate neutralizer sized for the total installed boiler capacity at the location.
   2. Route condensate through neutralization media prior to discharge to sanitary drainage.

2.5 BOILER OPERATION

A. Boilers shall operate in an automatic operating/standby sequence.

B. Controls shall automatically stage and modulate boilers to maintain supply water temperature.

C. Controls shall rotate lead assignment and equalize operating hours among boilers.

D. Refer also to Drawings for sequences of operation.

E. Communication:
   1. Provide factory installed hardware and software to allow the Building Automation System (BAS) to monitor and command the boiler plant.
   2. At a minimum, provide the following BACnet objects and points:
      a. Boiler enable/disable.
      b. Boiler status.
      c. Boiler alarm status.
      d. Boiler supply water temperature.
      e. Boiler firing rate.
      f. Boiler setpoint.
      g. Boiler lockout indication.
      h. Lead boiler designation.
      i. Outdoor air temperature, where utilized by the boiler controller.
   3. Communication shall be by native BACnet MS/TP or BACnet/IP.
   4. Furnish each BACNet device with a protocol information conformance statement (PICS).

2.6 BREECHING AND CHIMNEY

A. Provide venting design, height, and size as indicated on Drawings and in accordance with boiler Manufacturer's recommendations.

B. Vent materials shall be listed and approved by the boiler manufacturer for the application.

C. PVC vent materials shall not be permitted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Rough-Ins:
   1. Before boiler installation, examine roughing-in for piping and electrical connections to verify actual locations, sizes and other conditions affecting boiler performance, maintenance and operations.
   2. Boiler locations indicated on Drawings are approximate.
   3. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical space for suitable conditions where boilers will be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install gas fired boilers according to NFPA 54.

B. Boilers are to be hung from the wall in accordance with manufacturer recommendations.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

3.3 CONNECTIONS

A. General:
   1. Piping installation requirements are specified in other Division 23 sections.
   2. Drawings indicate general arrangement of piping, fittings and specialties.

B. Connect gas piping full size to boiler gas train inlet with union.

C. Connect hot water piping to supply boiler and return boiler tappings with shutoff valve and union or flange at each connection.

D. Install piping from safety relief valves to nearest floor drain.

E. Verify:
   1. Connect venting full size to boiler outlet.

F. Install piping adjacent to boiler to allow convenient service and maintenance.

G. Ground equipment according to Division 26 Section “Grounding and Bonding.”

H. Electrical Connections:
   1. Connect wiring according to Division 26.
   2. Tighten electrical connectors and terminals according to Manufacturer’s published torque-tightening values. If Manufacturer’s torque values are not indicated, use those specified in UL 486A and UL486B.

3.4 START-UP SERVICE

A. Engage a factory authorized service representative to test, inspect and adjust boiler components and equipment installation and to perform start-up service.

B. Perform installation and start-up checks according to Manufacturer’s written instructions.

C. Leak Test:
   1. Hydrostatic test.
   2. Repair leaks and retest until no leaks exist.

D. Operational Test:
   1. Start units to confirm proper motor rotation and unit operation.
   2. Adjust air-fuel ratio and combustion.

E. Controls and Safeties:
   1. Test and adjust.
   2. Replace damaged and malfunctioning controls and equipment.

F. Adjust initial temperature setpoints.

G. Set field adjustable switches and circuit breaker trip ranges as indicated.

H. Occupancy Adjustments:
   1. When requested within 12 months of date of Substantial Completion, provide onsite assistance in adjusting system to suit actual occupied conditions.
   2. Provide up to 2 visits to Site outside normal occupancy hours for this purpose, without additional cost.

I. Prepare written report that documents testing procedures and results.

3.5 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to operate and maintain condensing hot water boilers.

END OF SECTION 23 52 16

SECTION 23 74 43 – PACKAGED, OUTDOOR HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnished and installation of packaged rooftop air handling unit(s).

1.3 SYSTEM DESCRIPTION

A. General:
   1. Factory assembled packaged unit suitable for outdoor installation.
   2. All components functionally joined on a common base.
   3. Complete in every way, ready for electrical, ductwork, piping and control connections.

B. Major components shall be factory assembled and factory tested prior to shipment and include:
   1. Gas heating section.
   2. Filter module.
   3. Supply fan.
   4. Economizer section.
   5. Compressor/condenser system with DX coil.
   6. Factory-mounted controls.
   7. Hot gas bypass.
   8. Hot gas reheat.
   9. 120 Volt GFCI receptacle.
   10. Powered exhaust.

C. Design and performance requirements as indicated on the Drawings.

1.4 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the ASHRAE Standard: 90.1 – 2019 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, with state amendments.

1.5 SUBMITTALS

A. Shop Drawings: For complete unit.
   1. Manufacturer's name and model number.
   2. Dimensioned Drawings:
      a. Unit plan and elevation.
   3. Size and Performance Data:
      a. Fans.
      b. Refrigeration equipment.
      c. Heating section.
      d. Coils.
   4. Details of construction and installation.
   5. Project specific electrical wiring diagrams including controls wiring.
   6. Control schematic.

B. Operation and Maintenance Manuals: For completed unit and individual components.
   1. Equipment function, normal operating characteristics and limiting conditions.
   2. Assembly, installation, alignment, adjustment and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   4. Lubrication and maintenance instructions.
   5. Guide to "troubleshooting".
   6. Parts lists and predicted life of parts subject to wear.
   7. Outline, cross-sections, assembly drawings, engineering data and wiring diagrams.
   8. Test data and performance curves.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Manufacturer's Services:
   1. Provide start-up supervision by factory-employed personnel of installed unit.
   2. Provide training for Owner's personnel.

C. Regulatory Organizations Requirements:
   1. All electrical wiring must comply with NEC.
   2. Comply with all applicable state and local codes and ordinances.

1.7 SEQUENCING AND SCHEDULING

A. Expedite approval of Shop Drawings so as not to delay unit installation.

1.8 WARRANTY

A. Provide extended warranty of 5 years total on all compressors from equipment startup.

B. Provide manufacturer's standard heat exchanger warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Trane.

B. Aaon.

C. Addison.

D. Carrier.

E. York.

F. Design is based on equipment as scheduled. Changes in equipment Manufacturer must meet minimum requirements listed in this Specification or on Drawings and be compatible with facility and intended use. Contractor shall be responsible for any additional costs caused by selection of equipment from the list of acceptable alternative Manufacturers, including any redesign efforts by the Engineer.

G. Note that a listing above as an acceptable Manufacturer does not imply that all Manufacturers listed can furnish equipment which complies with the requirements for each unit used on this project.

2.2 CABINET, CASING AND FRAME

A. Cabinet shall be manufacturer's standard weather-resistant galvanized steel construction suitable for outdoor installation.

B. Unit shall provide hinged access doors with compression seals for service access to filters, controls, compressors, supply fan, and heating section.

C. Cabinet insulation shall be factory installed and comply with applicable UL requirements.

D. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

E. Sealants shall comply with EPA Method 24 40 CFR 59, Subpart D for VOC content.
   1. Metal to Metal: 30 g/L.
   2. Fiberglass: 80 g/L.

F. Insulation: Factory-installed insulation in accordance with manufacturer's standard construction and current energy code requirements.

2.3 SUPPLY FAN

A. Fan:
   1. Direct-drive supply fan assembly.
   2. Statically and dynamically balanced.

B. Motor: Factory-mounted direct-drive fan motor with VFD as required to provide scheduled airflow.

2.4 FURNACE

A. Burner:
   1. Factory-installed natural gas heating section with staged capacity control.
   2. Factory fire tested and adjusted prior to shipment.

B. Heat Exchanger:
   1. Factory-installed heat exchanger assembly.
   2. Fabricated of aluminized steel.
   3. Provide for heat exchanger cleaning.
   4. Provide manufacturer’s standard heat exchanger warranty.

C. Provide manufacturer’s standard factory-installed gas train and safety controls.

D. Control:
   1. Burner staging shall be controlled by the factory-installed unit controller.
   2. On-board control package shall include flame supervision, integral prepurge timing combustion air proving switch and intermittent pilot with spark ignition.

2.5 REFRIGERATION SYSTEM

A. Compressors: Compressors shall be factory-installed hermetic scroll type.

B. Condensing Coil:
   1. The condensing unit section shall be open on the sides to ensure complete access to and airflow through coils.
   2. Condenser coils shall be multi-row type fabricated from 3/8-inch O.D. seamless copper tubing mechanically bonded to rippled and corrugated aluminum fins.
   3. Each condenser coil shall be factory leak tested at 200 psig under water.

C. Condenser Fans:
   1. Condenser fans shall be direct drive, propeller type designed for low tip speed and vertical air discharge.
   2. Fan blades shall be constructed of steel and riveted to an Iridite dipped steel center hub.
   3. Condenser fan motors shall be heavy-duty, inherently protected, 3-phase nonreversing type with permanently lubricated ball bearings and integral rain shield.

D. Evaporator Coil:
   1. Evaporator coils shall be multi-row type fabricated seamless copper tubing mechanically bonded to aluminum fins, with a maximum of 12 fins per inch.
   2. Coils shall be factory leak tested.
   3. Provide manufacturer's standard refrigerant metering devices and coil circuitry.

E. Control:
   1. Refrigeration circuits shall be provided with manufacturer's standard safety and operating controls.
   2. Refrigeration circuits shall include high-pressure protection, low-pressure protection, anti-short-cycle protection, and condenser fan control as required for proper operation.
   3. Provide low ambient cooling capability where scheduled.

F. Condensate Drain:
   1. A stainless steel primary drain pan shall be provided with the cooling coil and extend beyond the leaving side of the coil and underneath the cooling coil connections.
   2. The drain pan shall be connected to a threaded drain connection extended through the unit base.

G. Hot Gas Reheat Coil:
   1. Factory piped to lead compressor circuit.
   2. Downstream of evaporator coil.
   3. Controlled in accordance with the requirements of Division 23 Section “Instrumentation and Control for HVAC.”

2.6 FILTER SECTION

A. Housing: Provide galvanized steel filter housing as integral section of unit with access doors.

B. Filters:
   1. Factory furnished filters.
   2. 2 inch depth, MERV 8.
   3. Provide clogged filter switch with 24-volt dry contact.

2.7 ECONOMIZER SECTION

A. Provide factory-installed economizer section complete with outdoor air hood, low-leak outdoor air and return air dampers, actuators, controls, and relief capability as required for proper operation.

B. Economizer shall be capable of providing up to 100 percent outdoor air for free cooling when outdoor conditions are suitable.

C. Relief Damper: Provide manufacturer's standard gravity relief system.

D. Outdoor and Return Air Dampers:
   1. Provide factory-furnished low-leak dampers meeting current energy code requirements.
   2. Dampers shall be factory mounted, linked, and controlled by the unit controller.

E. Provide factory weather hood, rain protection, and bird screen.

2.8 ELECTRICAL

A. Wiring:
   1. Each unit shall be wired and tested at the factory before shipment.
   2. Wiring shall comply with NEC requirements and shall conform with all applicable UL standards.
   3. All wiring shall be number coded in accordance with the electrical wiring diagrams.

B. Components:
   1. All electrical components shall be labeled according to the electrical diagram and be UL recognized where applicable.
   2. Each unit shall have the following:
      a. A 115 volt control circuit transformer.
      b. System service switch and control circuit fuse.
      c. 115 volt GFCI receptacle that will remain energized when unit disconnect is open.

C. Overload Protection:
   1. Motors shall be protected in accordance with manufacturer's standard construction and UL requirements.
   2. Contactors and inherent thermal overload protection shall be furnished for each compressor and condenser fan motor.
   3. Supply fan motor protection shall be provided in accordance with manufacturer's standard design.

D. Control Panel:
   1. Main control panel shall be of weatherproof construction with a dead-front cover over the main power circuit controls.
   2. Each BACnet device shall be BTL listed.
   3. Unit controller shall be BACnet compatible and capable of integration with the building automation system.

E. Connections:
   1. A terminal block shall be provided for the power connection and a terminal board shall be provided for the low voltage control wiring.
   2. Provide factory wiring entry locations in accordance with manufacturer's standard construction.

2.9 EQUIPMENT SUPPORT

A. Install unit on reinforced concrete housekeeping pad as indicated on the Drawings.

B. Concrete pad shall extend a minimum of 6 inches beyond the equipment perimeter unless otherwise indicated.

C. Coordinate pad dimensions, unit support locations, and required clearances with the equipment manufacturer.

D. Provide all anchor bolts, mounting hardware, and accessories required for a complete installation.

E. Install unit level and plumb

2.10 CONTROLS

A. Provide factory-installed microprocessor-based control package to provide the specified sequence of operation. Refer to Division 23 Section “Instrumentation and Control for HVAC.”
   1. Unit mounted control shall be capable of stand alone.
   2. Provide BACnet communication interface for integration with the Building Automation System.

B. Field-Mounted Components:
   1. Provide all sensors required to execute the specified sequence of operation.
   2. Duct Smoke Detectors:
      a. Provide dry contacts to allow shutdown of the unit by supply or return duct smoke detectors furnished under Division 26.
      b. Refer to Division 23 Section "Instrumentation and Control for HVAC."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that concrete pad, supports, and utility connections are ready to receive equipment.

B. Verify that proper power supply is available.

3.2 COMMISSIONING

A. In addition to the requirements above, the Manufacturer's representative shall be on Site for a minimum of 1 day to demonstrate compliance with operational intent and Start-up Checklists.

3.3 INSTALLATION

A. Install unit on concrete pad in accordance with Manufacturer's instructions.

B. Anchor unit in accordance with manufacturer's recommendations.

C. Contractor shall do all necessary interconnecting of wiring and assembly of sections if the units are shipped in sections.

D. Provide installation accessories as detailed, including installing P-traps on all units.

E. Contractor to install plastic piping for condensate drain.

F. Contractor shall install outside air hoods (furnished with unit) according to Manufacturer's instructions.

G. Air Cleaning: Refer to Division 23 Section "General HVAC Provisions" for construction period filter change requirements.

END OF SECTION 23 74 43

SECTION 23 81 13 – PACKAGED TERMINAL AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a packaged air conditioning unit(s).

1.3 SYSTEM DESCRIPTION

A. Provide complete packaged, factory assembled air conditioning units of the following types:
   1. Ductless split system air conditioning unit.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. As indicated on Drawings.

1.5 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. Division 23 Section “Hangers and Supports for HVAC Piping, Ductwork and Equipment.”
   2. AHRI Standards: 520 – Positive Displacement Refrigerant Compressors, Compressor Units, and Condensing Units.
   3. ASHRAE:
      a. Publications: 15 – Safety Code for Mechanical Refrigeration.
      b. Standards: 90.1 – 2019 – Energy Efficient Design of New Buildings Except Low Rise Residential Buildings, with state amendments.

1.6 SUBMITTALS

A. Required Information: For each computer room unit.
   1. Details of construction and installation.
   2. Name of Manufacturer.
   3. Model.
   4. Electrical characteristics.
   5. List of features and options included.
   6. Cooling fan performance characteristics.
   7. Rated capacities at specified conditions.

B. Shop Drawings:
   1. Dimensions.
   2. Service connection locations and sizes.
   3. Project specific wiring diagrams including controls wiring.

C. Operation and Maintenance Manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Agencies Requirements:
   1. Each unit shall be AHRI certified and bear the seal of said organization.
   2. Comply with all state and local codes and ordinances.

B. Product Options:
   1. Drawings indicate size, profiles and dimensional requirements of packaged air conditioners and are based on the specific system indicated.
   2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Energy Efficient Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings Except Low Rise Residential Buildings."

E. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings Except Low Rise Residential Buildings."

1.8 COORDINATION

A. Coordinate layout and installation of packaged air conditioners and wall construction with other construction that penetrates walls or is supported by them.

1.9 WARRANTY

A. Warranty period for seated refrigeration system shall be Manufacturer's standard, but not less than 5 years from date of Substantial Completion, including components and labor.

PART 2 - PRODUCT

2.1 DUCTLESS SPLIT SYSTEM AIR CONDITIONING UNIT

A. Manufacturer:
   1. Carrier.
   2. Mitsubishi.

B. Air System:
   1. Centrifugal direct-drive fan.
   2. Forward curved blades.
   3. Statically and dynamically balanced.
   4. Draw-through configuration.
   5. 1-inch thick, disposable pleated filter as specified in Division 23 Section "HVAC Air Cleaning Devices."
   6. Fresh air inlet knockouts.

C. Electrical:
   1. 208 volt, 60 hz, single phase.
   2. All internal components factory wired.
   3. Motor:
      a. Permanent split capacitor type.
      b. Provided with overload protection.
      c. Mounted on vibration isolators.
   4. Remote Thermostat:
      a. For field installation.
      b. 24 volt.
      c. Minimum Function:
         1) Fan ON/AUTO.
         2) Unit HEAT/OFF/COOL.
         3) Temperature setpoint.
   5. Electrical resistant heating elements as scheduled.

D. Coil:
   1. Seamless, mechanically-expanded, copper tubes arranged in staggered configuration with enhanced aluminum fins mechanically bonded.
   2. Tested to 460 psig.
   3. Comply with AHRI 210/240.

E. Refrigeration:
   1. Factory assembled and tested.
   2. Equipped with distributor/piston expansion device.
   3. Refrigeration line connections: Sweat type.

2.2 FAN COIL SPLIT SYSTEM AIR CONDITIONING UNIT

A. Manufacturers:
   1. Friedrich.
   2. Carrier.
   3. Mitsubishi.
   4. Trane.

B. Concealed Evaporator Fan Components:
   1. Chassis: Galvanized steel with flanged edges, removable panels for servicing and insulation on back of panel:
      a. Insulation: Faced, glass-fiber duct liner.
      b. Drain Pans: Stainless steel, with connection for drain; insulated.
   2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal expansion valve.
   3. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1-inch (2.5 mm); lead tested to 300 psig (2070 kPa) underwater; and having a 2 position control valve.
   4. Fan: Forward curved, double width wheel of galvanized steel; directly connected to motor.
   5. Fan Motor: Comply with the requirements of Division 23 Section “Common Motor Requirements for HVAC Equipment.”
   6. Disposable Filters: 1-inch (25 mm) thick, in fiberboard frames.
   7. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.3 PACKAGED TERMINAL AIR CONDITIONING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carrier Corporation.
   2. Friedrich Air Conditioning Company.
   3. GE Company; GE Appliances.
   4. Daikin Industries, Ltd.
   5. The Trane Company, North American Commercial Group.

B. Description: Factory assembled and tested, self-contained, packaged terminal air conditioner with room cabinet, electric refrigeration system, heating and temperature controls, fully charged with refrigerant and filled with oil:
   1. Power Supply: Cord connected chassis for 230/208 V units.

C. Cabinet: 0.052-inch (1.32 mm) thick, galvanized steel with removable front panel with concealed latches:
   1. Mounting: Wall with wall sleeve.
   2. Finish: Epoxy or baked enamel.
   3. Discharge Grille and Access Door: Extruded aluminum discharge grille, with hinged door in top of cabinet for access to controls.
   4. Wall Sleeves: Galvanized steel with polyester finish.
   5. Louvers: Extruded aluminum with enamel finish.

D. Refrigeration System: Direct expansion indoor coil with capillary restrictor, hermetically sealed scroll compressor with internal spring isolation, external isolation, permanent split capacitor motor and overload protection.

E. Indoor Fan: Forward curved, centrifugal or cross flow with permanent split capacitor motor and positive pressure ventilation damper:
   1. Motor: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements:
      a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
      b. Noise Rating: Quiet.
      c. Electrical devices and connections are specified in Division 26 – Electrical.

F. Filters: Washable polyurethane in molded plastic frame.

G. Electric Resistance Heating Coil: Nickel chromium wire, electric resistance heating elements with contactor and high temperature limit switch.

H. Condensate Drain: Drain pan to direct condensate to outdoor coil for re-evaporation with slinger ring around outside of outdoor fan.

I. Outdoor Fan: Forward curved, centrifugal or propeller type with separate permanent split capacitor motor:
   1. Motor: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements:
      a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
      b. Noise Rating: Quiet.
      c. Electrical devices and connections are specified in Division 26 – Electrical.

J. Controls:
   1. Control Module: Unit mounted adjustable thermostat with heat anticipator, off-heat-auto-cool switch, and high-low fan switch:
      a. Provide with micro-processor controls as indicated on the Drawings.
   2. Low Ambient Lockout Control: Prevents cooling cycle operation below 40 degrees F outdoor air temperature.
   3. Fan Cycle Switch: Allows fan operating mode to be either continuous or cycles on and off by thermostat.
   4. Temperature Limit Control: Prevents occupant from exceeding preset setback or setup temperature.
   5. Programmable Thermostat: Microcomputer based with automatic changeover from cooling to heating where indicated on the Drawings.
   6. Each BACnet device shall be BTL listed.
   7. Auto Defrost: Solid state sensor monitors frost buildup on indoor coil and stops compressor to melt frost.

2.4 AIR COOLED CONDENSING UNIT:

A. Casings:
   1. 20 gage galvanized steel.
   2. Exterior surface phosphatized, painted with epoxy primer, and finished with baked on polyester.
   3. Access panels shall be easily removed.
   4. Vinyl coated fan and coil guards.

B. Compressors:
   1. Accessible hermetic, protected from excessive current and temperatures by sensitive overload line break.
   2. Mounted on spring type vibration isolators.
   3. Maximum speed of 1,750 rpm.

C. Condenser Coil:
   1. Seamless, mechanically-expanded, copper tubes with enhanced aluminum fins mechanically bonded.
   2. Factory tested at 425 psi air pressure under water, vacuum dehydrated at 175 degrees F.

D. Condenser Fans and Drives:
   1. Direct drive with permanently lubricated bearings.
   2. Resiliently mounted, heavy duty motors with thermal and overcurrent protection.
   3. Statically and dynamically balanced propeller type aluminum fans, fan guards.
   4. Motor: Permanent split capacitor type.

E. Refrigeration:
   1. Precharged with refrigerant.
   2. Valves: Solid brass with sweat connections.

2.5 CONDENSATE PUMP:

A. General:
   1. Provided with internal sump and filter.
   2. Encapsulated electrical components.
   3. Discharge Flow: 1 gpm at 5 ft TDH.

B. Electrical:
   1. Factory wired to power supply terminals of ductless air conditioning unit.
   2. Pump shall switch on automatically upon sensing condensate.

2.6 SOURCE QUALITY CONTROL

A. Sound Power Level Ratings: Factory test to comply with AHRI 270, “Sound Rating of Outdoor Unitary Equipment.”

B. Unit Performance Ratings: Factory test to comply with AHRI 310/380, “Packaged Terminal Air Conditioners and Heat Pumps.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, maintaining Manufacturer’s recommended clearances and tolerances.

B. Secure roof mounted condensing unit to its support and its support to structural roof steel in a manner that meets maximum wind speed loads and complies with the IBC requirements.

C. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint sealant materials and applications are specified in Division 07 Section “Joint Sealants.”

3.2 CONNECTIONS

A. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches and motor controls.

B. Ground equipment according to Division 26 Section “Grounding and Bonding.”

C. Tighten electrical connectors and terminals according to Manufacturer’s published torque tightening values. If Manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Pipe Condensate Pump Discharge Connection:
   1. To nearest sanitary line as indicated on the Drawings.
   2. Pitch line at minimum 1/8-inch per foot.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Inspect for and remove shipping bolts, blocks and tie-down straps.
   2. After installing packaged air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and Adjust Controls and Safeties. Replace damaged and malfunctioning controls and adjustments.

B. Remove malfunctioning units, replace with new units and retest as specified above.

3.4 START-UP SERVICE

A. After installation, verify the following:
   1. Unit is level on base and is flashed in exterior wall.
   2. Unit casing has no visible damage.
   3. Compressor, air cooled condenser coil and fans have no visible damage.
   4. Labels are clearly visible.
   5. Controls are connected and operable.
   6. Shipping bolts, blocks and tie down straps are removed.
   7. Filters are installed and clean.
   8. Drain pan and drain line are installed correctly.

B. Verify that electrical wiring installation complies with Manufacturer's submittal and installation requirements in Division 23 Sections.

C. Complete installation and start-up checks according to Manufacturer's written instructions, including the following:
   1. Lubricate bearings on fan.
   2. Check fan wheel rotation for correct direction without vibration and binding.

D. After start-up service and performance test, change filters.

3.5 ADJUSTING

A. Adjust initial temperature and humidity setpoints.

B. Set field adjustable switches and circuit breaker trip ranges as indicated.

END OF SECTION 23 81 13

SECTION 23 82 19 – FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes furnishing and installation of fan coil units.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

A. Furnish and install fan coil units with arrangement as shown on Drawings. Air quantities and capacities as shown on Drawings.

B. Units shall be furnished completely factory assembled unless specific installation does not allow. If unit is required to ship in sections, then section assembly shall be as large as installation will allow.

C. The unit components shall operate on voltage as scheduled on the Drawings.

1.4 REFERENCES

A. As herein specified, the work of this Section shall comply with the following:
   1. ASHRAE Standard: 90.1 – 2019 Energy Efficient Design of New Buildings Except Low Rise Residential Buildings, with state amendments.

1.5 SUBMITTALS

A. Product Data: For Fan Coil Units.

B. Samples: Provide color samples for Approval by Architect.

C. Operation and Maintenance Manuals: Provide for Fan Coil Units, indicating the following:
   1. Equipment function, normal operating characteristics and limiting conditions.
   2. Assembly, installation, alignment, adjustment and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   4. Lubrication and maintenance instructions.
   5. Guide to "troubleshooting".
   6. Parts lists and predicted life of parts subject to wear.
   7. Outline, cross-sections, assembly drawings, engineering data and wiring diagrams.
   8. Test data and performance curves.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Storage:
   1. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, and damage by weather or elements, and according to Manufacturer's directions.
   2. Store equipment indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store off the ground in watertight enclosures.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.7 COORDINATION

A. Coordinate wiring requirements with the Electrical Subcontractor.

1.8 QUALITY ASSURANCE

A. Fan coil performance data shall be certified in accordance with AHRI Standard 430.

B. Coils shall be tested in accordance with AHRI Standard 440. Each coil shall be factory tested for leakage at 300 psig air pressure with coil submerged in water. Insulation and adhesive shall meet NFPA-90A requirements for flame spread and smoke generation. Adhesive shall be UL listed.

C. Fan coil units shall be Electrical Testing Laboratory (ETL) listed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fan coil units based on Enviro-Tec. Fan coil units by the following manufacturers of the same size, type, capacity and meeting other requirements may be furnished at the Contractor's option:
   1. IEC.
   2. Enviro-Tec.
   3. Carrier.
   4. Zehnder Rittling.

B. Fan coil units shall be horizontal cabinet as specified below, complete with heating coil, integral motorized control valves, insulated fan section, centrifugal blower, direct drive, 1-inch flat filter section, piping, wiring and controls.

C. Fan coil unit models and capacities as scheduled on the Drawings.

2.2 HORIZONTAL FAN COIL UNITS

A. Units shall be constructed of heavy gage steel with factory baked epoxy powder coating in manufacturer's standard paint color as selected by Architect. All ducted units shall have a minimum 1-inch duct collar on the return and/or discharge.
   1. Horizontal Hideaway Units:
      a. Hideaway cabinet panels shall be fabricated of 18 gage galvanized steel panels.
      b. Hideaway coil section shall be insulated with 1/4-inch thick elastomeric closed cell foam insulation.
      c. All plenum panels shall be insulated with 1/2-inch thick elastomeric closed cell foam insulation.

B. Insulation: 1/2-inch thick elastomeric closed cell foam insulation complying with ASTM C1071 and attached with adhesive complying with ASTM C916.

C. Return air/access opening shall provide access to all internal components.

D. All valve package piping to coil(s) shall be factory installed and insulated. Refer to the Piping Detail on the Drawings for valves and piping required.

E. Units shall have 1-inch throw away MERV 8 filters.

F. Fans shall be direct-drive, double-width fan wheels statically and dynamically balanced with forward-curved blades constructed of galvanized steel. Fans shall be easily removable.

G. Motors shall be 120 volt, 60 cycle, single phase, provided with three-speed ECM motor. ECM motor shall be provided with a fan speed switch capable of accepting different voltage values to a single analog input which corresponds to the fan speed. Electrical characteristics as indicated on the Drawings.

H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins rated for a minimum working pressure of 300 psig and a maximum entering-water temperature of 200 degrees F. Coils shall be circulated to maximize unit efficiency. Coil casing shall be fabricated from galvanized steel. Include manual air vent and drain valve.

I. Electrical Connection: Factory wire motors and controls for a single electrical connection.
   1. Provide a service disconnect switch to isolate power from the unit during maintenance.
   2. Provide control voltage transformer.

J. All insulation and filter material shall comply with NFPA requirements, Pamphlet 90A, and shall be UL listed with flame spread rating of 25 or less and smoke developed rating of 50 or less.

K. Units to have standard factory finish, color as selected by the Architect.

2.3 CONTROLS

A. Temperature Control Contractor shall provide and ship unit controllers to Manufacturer for factory mounting controllers.

B. Each BACnet device shall be BTL listed.

C. Unit Manufacturer shall factory install and wire sensors, controller, etc. to provide proper sequence of operation. Refer to Division 23 for requirements.

D. The DDC controls shall have the capability to control the following functions of the fan coil units through the controller:
   1. Fan On/Off.
   2. Fan Speed Low/Medium/High.
   3. Heating Hot Water Control Valve Open/close status.
   4. Occupied/Unoccupied temperature set points.
   5. Occupied/Unoccupied scheduling.
   6. Discharge air temperature.
   7. Room Temperature.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fan coil units to be installed in accordance with manufacturer's printed instructions.

B. Install new filters in each fan coil unit within two weeks after Substantial Completion.

C. Suspend horizontal type fan coils from structure with vibration isolator type hangers.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
   1. Install piping adjacent to unit to allow service and maintenance.
   2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.

B. For horizontal type fan coils, connect supply and return ducts to units with flexible duct connectors.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

3.5 COORDINATION

A. Coordinate with Temperature Control Subcontractor to verify proper operating sequence for all units with factory installed controls which interface with the building temperature control system.

B. Coordinate with Electrical Subcontractor for power supply to units equipped with fans.

END OF SECTION 23 82 19

SECTION 23 83 19 – RADIANT-CONVECTIVE HEATING WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes furnishing and installation of Runtal RF-1 radiant-convective heating wall panels and accessories.

1.3 SYSTEM DESCRIPTION

A. Runtal RF-1 hydronic radiant-convecive wall heating panels consisting of factory-fabricated steel radiant panels utilizing circulating hot water as the heating medium.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Provide Runtal RF-1 panels as scheduled on the Drawings with capacities as indicated. Performance shall be based on published ratings for Runtal RF-1 panels.

B. Heating capacities shall be based on Runtal published performance data at the scheduled entering water temperatures and room design conditions.

1.5 SUBMITTALS

A. Shop Drawings: Prepared specifically for Runtal RF-1 panels and including:
   1. Panel identification schedule indicating panel lengths, capacities, connection locations, and mounting details.
   2. Piping connection details, hanger locations.

B. Product Data:
   1. Manufacturer's descriptive literature marked to indicate products proposed.
   2. Current published Runtal RF-1 performance data, capacities, pressure ratings, and installation information..
   3. System installation details and instructions.

C. Samples:
   1. Radiant panel assembly approximately 12 inches long.
   2. Suspension system parts including trim, each piece being at least 12 inches long.

D. Certificates:
   1. Certification that submitted performance data is current published data for the specified Runtal RF-1 product.

E. Operation and Maintenance Data:
   1. Operation and maintenance of system.
   2. Cleaning and maintenance of finished panel surfaces.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.
   3. Authorized by Manufacturer to perform the Work.

B. Provide Manufacturer's field services.

1.7 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter and damage by weather or elements in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Runtal North America, Inc., RF-1 Radiant Convective Heating Panel.

B. Substitutions: Not permitted.

2.2 MANUFACTURED UNITS

A. Factory-fabricated steel panel construction as standard for Runtal RF-1.

B. Factory-integrated steel water passages and panel construction as provided by the manufacturer for RF-1 panels.

C. Finish: Manufacturer's standard powder-coated finish, color selected by Architect from manufacturer's full standard color range.

D. Maximum Working Pressure: As published by manufacturer for RF-1 panels.

E. Connections: Factory connections as indicated on Drawings.

2.3 ACCESSORIES

A. Provide all factory-recommended mounting brackets, suspension components, trim, fittings, and accessories required for a complete Runtal RF-1 installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Identify space conflicts before installing any of the work.

B. Consult with other trades as to the exact location and level of piping, ductwork, electrical and other work which may interfere with panels.

3.2 INSTALLATION

A. Install panels in conformance with:
   1. The Shop Drawings reviewed by Engineer.
   2. The Manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Arrange and pay for Runtal manufacturer's representative to check work.

B. Contractor to promptly make all changes and additions required by Runtal manufacturer's representative.

C. Submit Runtal manufacturer's representative's written approval of installation.

3.4 CLEANING

A. Clean, flush and test piping in accordance with Manufacturer's recommendations and Division 23 Section "Testing and Cleaning of HVAC Systems," prior to final connection to the heating water supply and return piping.

B. Clean all exposed surfaces.

END OF SECTION 23 83 19

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Excess Quantities and Sizes: Where quantities, sizes or other requirements on Drawings or Specifications are in excess of code requirements, Drawings or Specifications govern.

C. Conflicts: When conflicts exist between referenced Specifications or standards, more stringent requirements govern. No extra compensation for such compliance allowed.

1.2 SUMMARY

A. This Section includes the following:
1. Common electrical equipment coordination and installation requirements.
2. Penetrations for raceways and cables.
3. Penetration seals.
4. Grout.
5. Duct seal.
6. Duct sealing plugs.
7. Duct sealing foam.

1.3 REFERENCES

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

B. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014a.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.5 SUBMITTALS

A. Product Data For:
1. Penetration seals.
2. Duct sealing plugs.
3. Duct sealing foam.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, and damage by weather or elements, and according to Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, weather tight wrapping.

D. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To ensure that mounting heights and locations of electrical equipment do not interfere with all other building appurtenances such as, but not limited to, containment areas, special coatings, and other equipment.
   3. To allow easy access and disconnection of electrical equipment while ensuring the least amount of interference with other installations.
   4. To allow right-of-way for piping and conduit installed at required slopes.
   5. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and outside of the dedicated working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Hatches."

D. Surface repair:
   1. Coordinate the filling in or repair of surfaces around penetrations with other trades.
   2. Coordinate the filling in or repair of surfaces or structures for installation of supporting devices with other trades.
   3. Unused support penetrations/holes created as a part of new construction shall be filled in.
   4. Surfaces shall be filled in or repaired with the same materials that matches the construction and properties of the surface penetrated.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated on the Drawings.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 PENETRATION SEAL SYSTEMS

A. Description: Mechanical modular sealing device, designed for field assembly, to fill annular space between penetration and raceway or cable.

B. Manufacturers:
1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.
6. Or equal.

C. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

D. Pressure Plates: Glass reinforced plastic.

E. Connecting Bolts and Nuts: Stainless Steel. Include one for each sealing element.

2.3 GROUT

A. Coordinate the selection and application of grout with other trades in order to match the color and properties of the surface being repaired, where applicable. In existing construction, grout shall match existing color and material properties.

B. At a minimum grout shall be:
1. Nonshrink; recommended for interior and exterior for sealing openings in non-fired-rated walls or floors.
2. Standard: ASTM C1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5,000 psi, 28 day compressive strength.
4. Packaging: Premix and factory packaged.

2.4 DUCT SEAL

A. Description: UL listed, pliable, non-hardening, non-corrosive, weather-proof putty material, designed as a moisture barrier for weather-sealing service entries, electrical cables, and conduit ducts.

B. Manufacturers:
1. Arnco Corp. - Hydra-Seal.
2. Ilsco Corp. – DS Duct Seal.
3. JM Clipper – Duxseal.
4. OZ/Gedney Co. – DUX.
5. RectorSeal - Duct Seal Compound.
6. Thomas & Betts Corp. - DX.
7. Or equal.

2.5 DUCT SEALING PLUGS

A. Cable duct sealing plugs shall be designed to effectively seal conduits, reducing the cost of cable placement and maintenance in underground construction projects and routine work.
   1. All plastic construction – corrosion proof.
   2. Pull 'Rope Eye' attachment (can be supplied with security hex nut).
   3. Watertight.
   4. Simple to install.
   5. Removable and reusable.
   6. Full range of sizes.
   7. Full range of forms (round, square).
   8. Full range of supported cable count (simplex, duplex, triples, quadplex, and specials).

2.6 DUCT SEALING FOAM

A. Closed-cell sealant shall be designed to create a watertight and gas-tight seal in conduits, reducing the cost of cable placement and maintenance in construction projects and routine work.
   1. Properties:
      a. Closed-cell Percentage: 98%.
   2. Density: 6lbs/ft^3.
      a. Moisture Absorption: <4%.
      b. Compressive Strength: 145 psi.
      c. Seal Strength – Water: 90ft intermittent, 22ft continuous.
      d. Seal Strength – Air: >5 psi.
   3. Reusable, re-enterable, and capable of sealing up to 12" conduits.
   4. Sealant shall be compatible with common conductor/cable jacket materials. Cured foam shall not affect physical or electrical properties of conductors/cables.
   5. Suitable for us in temperatures ranging from -20 degrees to 200 degrees Fahrenheit.
   6. Chemically resistant to gasoline, oils, dilute acids and bases, ad most unsaturated hydrocarbon.
   7. UL recognized. Complies with NEC and TIA.

B. Provide all accessories required for a complete installation.

C. Manufacturers:
   1. Polywater #FST.
   2. Or equal.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1 and NFPA 70 (NEC).

B. Measure indicated mounting heights to bottom of suspended items and the top of wall mounted items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in a manner as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Verify final rough-in locations using field measurements and the specific requirements of the equipment to be connected.

G. Coordinate equipment rough-in with Division 02 through Division 28.

H. Coordinate application of firestopping in Division 07 Section “Firestopping”.

3.2 INSTALLATIONS FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate:
   1. Exterior walls or slabs.
   2. Fire-rated floor and wall assemblies.
   3. Interior non-rated floor and wall assemblies.

B. Use core drilled holes, formed openings, or pipe sleeves for all penetrations unless penetration arrangement requires a rectangular sleeved opening or otherwise indicated herein or on the Drawings.
   1. When using a pipe sleeve:
      a. Use cast-iron pipe sleeves with integral water stop in new construction only. Coordinate installation of pipe sleeve with wall/slab construction.
      b. Use steel pipe sleeve in existing construction or new above grade interior construction.
   2. Obtain approval from Engineer before using rectangular sleeved openings not indicated on the Drawings.

C. Pipe Sleeve Installation:
   1. In walls, cut sleeves to length for mounting flush with both surfaces of walls.
   2. In floors, extend sleeves installed in floors 2 inches above finished floor level.
   3. Size sleeve to provide a minimum 1/4-inch annular clear space between sleeve and raceway or cable, unless otherwise indicated herein or on the Drawings. When using a modular mechanical seal, provide annular space between sleeve, raceway, or cable as required by seal Manufacture.
   4. Seal space outside of sleeves. Seal shall match existing surface construction and properties. When grout or similar compound is used promptly pack solidly between sleeve and wall so no void remains. Tool exposed surfaces smooth; protect while curing.

D. Penetration Types:
   1. Fire-Rated Assembly Penetrations:
      a. Apply firestopping to penetrations to maintain fire rating of walls, partitions, ceilings, and floors at penetrations. Seal penetration with firestop materials. Comply with the requirements in Division 07 Section “Penetration Firestopping."
      b. Where available, reference Architectural Drawings and record documents for fire ratings of walls and floors.
   2. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between penetration and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
      b. Comply with requirements in Division 07 Section "Joint Sealants."
      c. Repair surface to match finish and properties of penetrated surfaces.
   3. Roof-Penetrations:
      a. See Division 26 "Raceways for Electrical Systems" for raceway requirements.
      b. Seal annular space between penetration and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
      c. Comply with requirements in Division 07 Section "Joint Sealants."
      d. For new roofing installation penetrations, seal all penetrations of individual raceways as required by the roofing Manufacturer to maintain the roof warranty. Coordinate work with other trades.
      e. For existing roofing installation penetrations, Seal all penetrations of individual raceways with flexible boot-type flashing units.

f. Roof penetrations shall require the installation of duct sealing plugs or foam in raceways. Duct sealing foam shall be used when duct sealing plugs are not available in the size or configuration required.
g. A conduit body or junction box shall be installed on interior side of penetration for installation of, and future access to, plug or foam.

4. Exterior-Wall and Elevated Slab Penetrations:
   a. Seal penetrations using mechanical modular seals. Size penetrations as required to install mechanical modular seal.
   b. Exterior penetrations shall require the installation of duct sealing plugs or foam. Duct sealing foam shall be used when duct sealing plugs are not available in the size or configuration required.
   c. Repair surface to match finish and properties of penetrated surfaces.
   d. A conduit body or junction box shall be installed on interior side of penetration for installation of, and future access to, plug or foam.
5. Manhole and Vault Penetrations:
   a. Seal penetrations using mechanical modular seals. Size penetration as required to install mechanical module seal.
   b. Manholes and vault penetrations shall require the installation of duct sealing plugs or foam. Duct sealing foam shall be used when duct sealing plugs are not available in the size of configuration required.
   c. Where raceways will terminate to equipment within a manhole or vault, a conduit body or junction box shall be installed at penetration for installation of duct sealing plug or foam.
   d. Repair surface to match finish and properties of penetrated surfaces.
6. Varied Temperature Penetrations:
   a. Penetrations where raceways will be simultaneously exposed to different temperatures on each side of the penetration such as freezers, coolers, or room to room where the temperature variation is greater than 10 degrees Fahrenheit and one side of the room will be 60 degrees or less.
   b. Seal penetrations using mechanical modular seals where penetrated material permits. Size penetrations as required to install mechanical modular seal. Where modular mechanical seals cannot be utilized use clear silicone caulk or grout as applicable.
   c. Inside of the raceway shall be sealed with duct sealing plug or foam. Duct sealing foam shall be used when duct sealing plugs are not available in the size of configuration required.
   d. A conduit body or junction box shall be installed on the higher temperature side of penetration for installation of, and future access to, plug or foam.
   e. Repair surface to match finish and properties of penetrated surfaces.

3.3 PENETRATION SEAL SYSTEM INSTALLATION

A. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 DUCT SEAL INSTALLATION

A. Obtain approval from Engineer prior to installing duct seal.

B. Duct sealing plugs or duct sealing foam to be utilized in lieu of duct seal unless noted otherwise.

C. Install duct seal materials in strict accordance with the Manufacturer’s instructions

3.5 DUCT SEALING PLUG INSTALLATION

A. Where required as indicated above, seal duct openings to prevent migration of water and gases into a space or enclosure.

B. Duct sealing plugs shall be applied after all cables have been installed.

C. Install duct sealing plug materials in strict accordance with the Manufacturer's instructions.

D. All open-ended riser conduits shall require duct sealing plugs to be installed.

3.6 DUCT SEALING FOAM INSTALLATION

A. Where required as indicated above, seal duct openings to prevent migration of water and gases into a space or enclosure.

B. Duct sealing foam to be installed after all cables have been installed.

C. Install foam sealant in strict accordance with Manufacturer's installation instructions.

D. Install conduit body or junction box at interior side of penetration where foam sealant is to be installed.

E. Abrade interior surface of duct with sandpaper or steel wool. Clean cables/conductors and interior of duct. Install foam strips/foam backer inside raceway around cables to fill annular space. Foam to be pushed back into raceway to a depth as specified by manufacturer. Install foam strips/foam backer inside raceway at front of raceway. Fill annual space between both foam backers with foam sealant product. Trim cured foam as required. Check for voids in cured foam and fill voids as required.

END OF SECTION

SECTION 26 05 20 - CONDUCTORS AND CABLES 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all electrical conductors, cables, splices, and connectors.

B. Major Systems Include:
1. 600V and below service entrance, feeders and electrical distribution.
2. Branch circuit wiring.
3. System wiring.

1.3 REFERENCE STANDARDS

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the standards of the following organizations as applicable to materials, construction and testing of wire cables:
1. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
2. NFPA 79 - Electrical Standard for Industrial Machinery; 2024.

B. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
1. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

C. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.
1. NEMA - National Electrical Manufacturer Association Standards.
2. IEEE Standards.
3. Insulated Cable Engineers Association - Standards.
4. ASTM Standards.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed submittals.

B. Manufacturers: Firms regularly engaged in the manufacture of electrical conductor and cable products of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Except as otherwise indicated, provide conductors, cables, and connectors of Manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by the Manufacturer and as required for the installation.

B. Power Wire:
   1. All conductors and cables shall be new with a minimum wire size of No. 12 AWG. Manufacturer's name, type, and size shall be permanently marked on the outer covering at regular intervals and delivered in complete coils or reels.
   2. Provide factory fabricated conductors of size, rating, material, and type as indicated for each service. Where not indicated, provide proper selection as determined by installer to comply with installation requirements and with NPFA 70 (NEC) standards, from only the following types and conductors:
      a. Type THHN/THWN-2 dual rated, 600-Volt, 90 degrees Celsius rated. Stranded copper for all sizes.
      b. Bare Conductors: Stranded copper for all sizes.

C. Metal Clad (Type MC) Cables:
   1. Type THHN/THWN-2 insulated copper conductors, with insulated green grounding conductor routed with the circuit conductors.
   2. High strength, lightweight, galvanized steel flexible interlocking armor, listed and labeled for UL 1569 and UL 83 .
   3. Thermoplastic insulated bushing for each cable end.
   4. Manufacturers: MCTUFF Lightweight Steel MC Metal Clad Cables by AFC Cable Systems; or equal.

D. Control Cable: No. 14 AWG minimum, copper, type THHN/THWN-2.

E. Instrumentation Signal Cable:
   1. One pair of No. 16 AWG stranded, tinned copper conductors, 600V polyethylene insulation, twisted pair, 100% coverage aluminum polyester shield, No. 18 AWG stranded, tinned copper drain wire with vinyl outer jacket, UL listed.
   2. For use outdoors, below grade, above grade, and inside control panels.
   3. Where more than 2 conductors are required for an instrument, provide multiple cables.
   4. Manufacturers: Belden 8719; or equal.

F. Power Wiring Cable Accessories for connectors/splices:
   1. Provide connector/splicing devices of type and manufacturer indicated below as required:

a. Wing nuts by Ideal.
b. Sta-Kon by ABB.
c. Scotchlox Spring by 3M.
d. Compression Type by Burndy.
e. Pin adaptors (reducers) by Burndy.
f. Hydent by Burndy.
g. Insulated multi-cable mechanical connector blocks by Polaris or Ilsco.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install electrical conductors, cables, and connectors as indicated on the Drawings, in accordance with the Manufacturer's written instructions, the applicable requirements of the National Electrical Code, the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices to ensure that products serve the intended functions.
2. Conductors and cables shall be sized in accordance with the Drawings or, in the absence thereof, in accordance with National Electrical Code requirements. Except where indicated herein, conductor sizes greater than No. 12 AWG are indicated on the Drawings.
3. Provide a dedicated grounded conductor (neutral) for each circuit that requires a neutral for proper operation. Unless indicated otherwise on the Drawings, shared neutrals are not allowed.
4. Provide an equipment grounding conductor in all raceways. Conductor shall be sized in accordance with the National Electrical Code.

B. Voltage Drop Compensation:
1. Provide No. 10 AWG conductors in lieu of No. 12 AWG conductors to compensate for voltage drop as follows:
a. For each 277V, 20 ampere branch circuit that exceeds 200 feet in length between the branch circuit panelboard and the last outlet.
b. For each 120V, 20 ampere branch circuit that exceeds 100 in length between the branch circuit panelboard and the last outlet.
2. When conductor size is increased to compensate for voltage drop, provide equipment grounding conductor increased in size in accordance with (NEC).

C. Conductor Derating:
1. Conductor ampacity derating shall be adhered to for all conductors in accordance with the National Electrical Code.
2. Neutral conductors shall be considered current carrying conductors.

D. Installation Procedures:
1. Install interior conductors and cables after building is enclosed and water tight.
2. Each conduit shall be free of moisture and debris before conductors are installed.
a. Remove moisture from conduits by swabbing.
3. Conductors and Cables:
a. Install such that insulation is not damaged. Conductors or cables with damages insulation shall be replaced.
b. Install conductors and cables only in code conforming raceway.
c. Pull conductors and cables together where more than one is being installed in a raceway.
d. Use heat shrink tubing for all instrument signal cable terminations.
e. Make conductor length for parallel feeds identical.
f. Where exposed conductors or cables are installed, install parallel and perpendicular to exposed structural members and building lines.
g. Do not lace, strap or tie feeder or branch circuit conductors together in panels, switchboards, variable speed drives, motor control centers, automatic transfer switches, boxes, and wireways.

h. Support conductors in vertical raceways in accordance Division 26 Section “Hangers and Supports for Electrical Systems".

4. Pulling:
   a. Use manufacturer-approved pulling compound or lubricant, where necessary. Compound shall not deteriorate conductors and insulation. Compounds shall be UL listed.
   b. Use a pulling means, including fish tape, cable or rope, and basket-weave wire/cable grips that will not damage the raceway or the conductor or cable.
5. Splicing:
   a. Keep conductor splices to a minimum.
   b. Install splices and taps which have equivalent or better mechanical strength and insulation as the conductor.
   c. Use splice and tap connectors which are compatible with the conductor material.
   d. Make all joints, splices, and connections only at accessible junction or outlet boxes, never inside conduit or fitting.
      1) Make splices in No. 10 AWG and smaller wire with insulated spiral mechanical connectors.
      2) Make splices in No. 8 AWG and larger copper wire with compression type mechanical connectors. Install compression type connectors in strict accordance with manufacturer's installation instructions using manufacturer approved tools.
   e. All splices located in handholes and wet locations shall be rated for wet locations.
   f. Low voltage and signal cable splices located in handholes and wet locations shall be sealed in 2-part epoxy sealing pack, 3M Scotchcast connector sealing pack 3570G.
6. Terminations:
   a. Utilize terminations provided by equipment or device manufacturer. Provide appropriate connectors (i.e., compression lugs) where required.
   b. Provide and install irreversible pin adaptors (reducers) if the lug sizes on equipment are smaller than the wire specified.
7. Identification:
   a. All conductors and cables shall be labeled/identified in accordance with Division 26 Section “Identification for Electrical Systems.”
   b. Use color coded conductors as follows:
      1) For Power Distribution:
         (a) Phases: Black-red-blue (under 150V to ground).
         (b) Phases: Brown-orange-yellow (over 150V to ground).
         (c) Neutral: White (under 150V to ground).
         (d) Neutral: Grey (over 150V to ground).
         (e) Ground: Green identified (feeders); Green (branch circuits).
      2) For Controls:
         (a) Follow industry standards (UL 508A and NFPA 79) for coloring associated with control circuits and control panels:
            (1) AC Ungrounded (Hot) Circuits: Red.
            (2) DC Ungrounded (Hot) Circuits: Blue.
            (3) AC Grounded (Neutral): White or Gray.
            (4) DC Grounded (Neutral): White with Blue Stripes.
            (5) Ungrounded (Hot) Circuits which remain energized when main switch is off: Orange or Yellow.
            (6) Grounded (Neutral) Control Circuits which remain energized when main switch is off: White with Yellow or Orange Stripes.
            (7) Equipment Grounding Conductors: Green.
8. Outlets:
   a. Leave at least 6 inches of free conductor at all outlets except where conductors are intended to loop without joints through outlets for fixtures or wiring device hook-ups.
   b. Free ends and loops at boxes and enclosures shall be pushed back into boxes and protected by blank cover plates or other means until interior painting and decorating work is completed.
9. Circuit Grouping:
   a. Lights and outlets shall be grouped on circuits as indicated on the Drawings.
   b. Different types of circuits such as feeders, branch circuits, control circuits, and signal circuits, shall not be mixed in common conduit runs and shall be run separately.
   c. More than one circuit of the same system may be run in common conduit runs.

E. MC Cable:
   1. Type MC cable may only be used for fixture whips above dropped ceilings, from junction boxes to individual lighting fixtures, and in existing walls and ceilings. Type MC cable shall originate from accessible junction boxes above ceilings. Do not daisy chain fixtures. Fixture whips not to exceed 6-feet.

3.2 FIELD QUALITY CONTROL

A. General:
   1. Prior to energization, check conductors and cables for continuity of circuitry and for short circuits. Correct malfunctions when detected.
   2. Subsequent to conductor and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

END OF SECTION

SECTION 26 05 27 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a complete and continuous grounding system.

1.3 SUBMITTALS

A. Test Reports: For grounding. Grounding electrode resistance test results.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. All equipment, raceway systems, interior wiring systems with neutrals, receptacles, and power outlets, motors and motorized equipment shall be grounded.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design.

B. Grounding system shall be in accordance with the current National Electrical Code (NEC).

C. Grounding system rods, connectors and clamps shall be UL labeled.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: A portion of the required materials for grounding systems are specified in the Division 26 – Electrical Sections.

B. Grounding Electrodes:
   1. Ground Rods: Copper-clad steel; 3/4-inch diameter by 10 feet in length.
   2. Where ground grids are required they shall consist of copper clad steel driven rods with underground ring bus, sized as indicated on Drawings, of bare stranded copper interconnecting cable.
   3. Ground rods to be as manufactured by Copperweld; or equal.

C. Connectors:
   1. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions as manufactured by Thomas and Betts; or equal.

2. Irreversible Compression Connectors: Compression connections shall be irreversible, cast copper, high conductivity as manufactured by Thomas and Betts; or equal.

D. Telecommunications Grounding Busbar:
1. Telecommunications Main Grounding Busbar (TMGB): Rectangular, electro-tin plated, annealed, copper busbar; 1/4-inch x 4-inch x 14 -inch; with insulators, stainless steel mounting brackets, and fasteners. Manufacturer: nVent Erico #TMGB or equal.
2. Telecommunications Grounding Busbar (TGB): Rectangular, electro-tin plated, annealed, copper bus bars; 1/4-inch x 2-inch x 14 -inch; with insulators, stainless steel mounting brackets, and fasteners. Manufacturer: nVent Erico #TGB or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Where provided, provide grounding and bonding as indicated in grounding details on the Drawings.

B. Installations shall be in accordance with the NEC as adopted by the Authority Having Jurisdiction.

3.2 POWER SYSTEM GROUNDING

A. Provide ground rod grids as indicated on Drawings and in the Specifications. Provide a ground grid around all outdoor pad mounted equipment with the exception of generators utilizing a transfer switch that does not switch the grounded conductor (neutral), as these are not considered a separately derived system, as indicated in the NEC.

B. Make cable to rod and cable to cable connections by using exothermic-welding process, or irreversible compression type connectors made for direct burial.

C. Welds on ground cables shall be cleaned and painted with an asphalt base paint where buried underground or embedded in concrete.

D. Irreversible compression connectors shall be factory filled with an oxide inhibitor and installed with the connector manufacturer’s die such that the die index matches the listed index on the connector. Connectors shall be fully crimped with a 14 ton or larger hydraulic tool such that the index number is embossed on the connector. Irreversible compression connectors may be used in below grade, above grade, building steel, electrode connections and concrete encased applications. Connectors shall comply with IEEE 837, UL 467 and CSA22.2.

E. Connect grounding electrode conductors to service entrances and separately derived systems in accordance with the NEC.

F. Provide a grounding electrode connection to the water service in accordance with the NEC.

G. Provide a grounding electrode connection to the building steel in accordance with the NEC.

H. Provide a grounding electrode connection to any concrete encased electrodes (building/slab rebar) in accordance with the NEC.

I. Top of ground rods to be within 2'-0" of finish grade. Rod to extend 10 feet into undisturbed soil.

3.3 DISTRIBUTION SYSTEM GROUNDING

A. Provide a green, insulated, equipment grounding conductor in each raceway (metallic and non-metallic; rigid and flexible). Equipment grounding conductors shall be sized in accordance with Article 250 of the NEC.

B. Circuit Grounding: Install grounding bushings, grounding studs, and grounding jumpers at distribution centers, pull boxes, motor control centers, panelboards, load centers, and all like equipment.

C. Bonding Jumpers:
   1. Provide green insulation, size correlated with overcurrent device protecting the wire, attached to grounding bushings on conduits, to lugs on boxes, and other enclosures.
   2. Bond to neutral only at service neutral bar.

D. Receptacles and Power Outlets: Ground receptacles and power outlets to the conduit system with a green grounding conductor sized in accordance with Article 250 of the NEC and connected between the device grounding screw and outlet box.

E. Metallic Conduit:
   1. Metallic conduit shall not be used as an equipment grounding conductors without approval of Engineer.
   2. When bare grounding electrode conductors are enclosed in metallic conduit, the conduit shall be bonded to the grounding electrode conductor(s) at both ends utilizing equipment UL listed for this purpose.

F. Motor bases and frames shall be bonded to the equipment grounding conductor pulled in with the motor branch circuit.

G. Expansion Joints: Provide a bonding jumper around expansion fittings in metallic conduit to maintain ground continuity. Expansion fittings may include an internal bonding jumper constructed of a tinned copper braid, sized to meet UL fault current test requirements and complying with the bonding requirements of Article250 of the NEC.

H. Separately Derived Systems: Grounding of separately derived systems, i.e., secondary transformers, shall be in accordance with Article 250 of the NEC. Use suitable ground lugs and clamps approved for this purpose.

3.4 TELECOMMUNICATIONS SYSTEMS GROUNDING

A. Main Telecommunications Room:
   1. Install a Telecommunications Main Grounding Busbar (TMGB) in the main telecommunications room.
   2. Provide a No. 4 AWG, insulated grounding conductor in non-metallic conduit, to bond the TMGB to the building’s grounding electrode system.

B. Intermediate Telecommunications Rooms:
   1. Install a Telecommunications Grounding Busbar (TGB) in each intermediate telecommunications room.
   2. Provide a No. 4 AWG, insulated grounding conductor in non-metallic conduit, to bond each TGB to the TMGB in the main telecommunications room.

3.5 FIELD QUALITY CONTROL

A. Tests:
   1. Measured resistance of grounding electrode system to ground shall be 5 Ohms or less. Perform Earth Ground Resistance (Fall of Potential) tests and provide additional grounding electrodes to grounding electrode system until measured resistance to ground is 5 ohms or less.
   2. Transmit test results to Engineer.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the following:
   1. Hangers and supports for electrical equipment and systems.

1.3 REFERENCE STANDARDS

A. MFMA-4 - Metal Framing Standards Publication; 2004.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 DEFINITIONS

A. Electrical Supports: Angles, channels, brackets, and mounting accessories for supporting all conduit, luminaires, switches, and other electrical equipment which are hung or mounted above floor.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. This Section defines general criteria for the selection and installation of supporting devices, but does not cover all types specifically required for the Project.

B. Choose or design supporting devices in accordance with these general criteria.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Regulatory Agencies Requirements:
   1. NFPA 70 (NEC).
   2. Provide supporting devices listed by Underwriters' Laboratory for their application as installed.
   3. Comply with Metal Framing Manufacturers Association Standard Publication (MFMA-4); factory-fabricated components for field installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer’s directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit Supports:
   1. Where information indicated on Drawings conflicts with information herein, the more stringent requirements shall take precedence and the better quality or greater quantity of work shall be provided.
   2. Single Runs: Galvanized conduit straps or ring bolt type hangers with spring clips. Do not use plumber's perforated straps.
   3. Use 316 stainless steel supports in corrosive areas. All hardware used in corrosive areas shall be 316 stainless steel.
   4. All supports, such as, but not limited to, metal channel (strut) framing systems, angles, straps, hangers, etc. shall match the raceway type that is being supported. For example:
      a. Galvanized conduit requires galvanized metal channel (strut) framing systems and straps.
      b. PVC coated conduit requires PVC coated metal channel (strut) framing systems and straps.
      c. PVC conduit requires PVC channel (strut) framing systems and straps.
   5. In general, all hardware, such as anchors, nuts, bolts, washers, threaded rod, etc. shall match the conduit type:
      a. Galvanized steel hardware shall be used with galvanized steel rigid metal conduit.
      b. 316 stainless steel hardware shall be used with PVC and PVC coated rigid metal conduit.
   6. Multiple Runs: Conduit rack with 25% spare capacity.
   7. Vertical Runs: Channel support with conduit fittings.
   8. Manufacturers:
      a. Eaton; B-Line Series.
      b. nVent ERICO.
      c. Power Engineering Co., Inc.; Power-Strut.
      d. GS Metals Corp.
      e. National Pipe Hanger Corporation.
      f. ABB Installation Products (Thomas & Betts).
      g. Unistrut; a brand of Atkore International, Inc.
      h. Wesanco-ZSI (ZSi-Foster, Inc).
      i. Or equal.

B. Mounting, Anchoring, and Attachment Components
   1. Mechanical-Expansion Anchors: Insert-wedge-type, 316 stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   2. Manufacturers:
      a. Hilti, Inc.
      b. ITW Construction Products.
      c. MKT Fastening, LLC.
      d. Or equal.

C. Supports for Conductors in Vertical Conduit:
   1. Install in compliance with NFPA 70.
   2. Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads.
2. Secure Engineer's approval before welding or bolting to steel framing or anchoring to concrete structure.
3. Where equipment is to be suspended from cast-in-place concrete construction, set approved concrete inserts in formwork to receive hanger rods. Where equipment is to be suspended from metal deck and beam or joist construction, support equipment from beams or joists only.
4. Do not use existing supports without approval from Engineer and Owner.

END OF SECTION

SECTION 26 05 34 - RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of conduits and fittings for electrical wiring.

1.3 CONDUIT SCHEDULE

A. Where information on the Drawings conflicts with information herein, the more stringent requirements take precedence and the better quality or greater quantity of work shall be provided.

B. All conduit shall be 3/4" minimum.

C. Feeder Circuit, Branch Circuit, System, and Data Conduits:
   1. Underground and In or Below Concrete: RMC, IMC, and RNMC.
   2. Roof:
      a. Unexposed Penetrations into Equipment:RMC, IMC, EMT, and RNMC.
      b. Exposed Penetrations or Routed on Roof: RMC.
   3. Above Slab or Grade:
      a. Exposed Conduit Below 10'-0" AFF:
         1) Where subject to physical damage: RMC and IMC.
         2) Where not subject to physical damage: EMT.
      b. Exposed Conduit Above 10'-0" AFF: EMT.
      c. Concealed In Walls:
         1) In Walls: EMT.
         2) Above Ceiling: RMC.
   4. Wet Locations: RMC.
   5. Underground Duct Banks:
      a. Encased In Concrete: RNMC, HDPE, and EB.
      b. Not Encased In Concrete: RNMC and HDPE.

D. Connection To Equipment:
   1. Connections to equipment include final connections to light fixtures, motors, transformers, equipment mounted on vibration isolators, control devices, and instrumentation.
   2. See installation requirements herein for limitations on use of flexible conduits.
   3. Connections to equipment shall utilize the following conduit types:
      a. Dry Locations: FMC.
      b. Wet or Damp Locations: FMC.

1.4 SUBMITTALS

A. Product Data:
   1. Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design.

B. Regulatory Agencies Requirements:
   1. ACI 350-20 - Environmental Engineering Concrete Structures; 2021.
   2. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
   3. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter; 2022.
   4. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials; 2025.
   5. ASTM F2160 - Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD); 2022a.
   6. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
   7. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
   8. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
   9. NEMA BI 50063 - Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations; 2025.
   10. NEMA TC 7 - Solid-Wall Coilable and Straight Electrical Polyethylene Conduit; 2021.
   11. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   12. UL 651A - High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner that will prevent deterioration or damage (e.g., bending, end damage, finish scoring), contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping. Provide color coded end cap thread protectors on exposed threads of threaded metal conduit.

D. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rigid Metal Conduit (RMC):
   1. Galvanized Steel RMC: Galvanized steel, heavy wall conduit with threaded fittings, insulated bushings.

B. Intermediate Metal Conduit (IMC):
   1. Galvanized Steel IMC: Reduced wall galvanized steel conduit with threaded fittings, insulated bushings.

C. Electrical Metallic Tubing (EMT):
   1. Thin wall, hot galvanized, steel tubing, insulated throat steel connector.
   2. Fittings: Steel setscrew type (die cast fittings are expressly prohibited).

D. Rigid Nonmetallic Conduit (RNMC):
   1. Schedule 40 rigid polyvinylchloride, rated for 90 degrees C conductors, solvent cement connectors and couplings.
   2. Nonmetallic strap hangers allowing thermal expansion movement.
   3. Conduit to meet NEMA TC 2; fittings to meet NEMA TC 3.
   4. Expansion Coupling: Nonmetallic to compensate for thermal expansion.

E. Flexible Metal Conduit (FMC): Galvanized steel flexible conduit insulated throat steel connectors.

F. Liquid Tight Flexible Metal Conduit (LTFMC): Flexible conduit with flexible, moisture-proof PVC jacket and liquid tight connectors.

G. Encased Burial (EB): PVC, rated for 90 degree C conductors, 2-inch to 6-inch trade size, solvent cement connectors and couplings. Meet NEMA TC 6 & 8.

H. High Density Polyethylene (HDPE):
   1. Conduit to meet the following standards:
      a. UL 651A.
      b. ASTM F2160, ASTM D3036, and ASTM D3350.
      c. NEMA TC 7.
   2. Conduit shall be factory-lubricated, low-friction, schedule 40, HDPE conduit.
   3. Conduit shall be capable of being coiled on reels in continuous lengths, transported, stored outdoors, and subsequently uncoiled for installation; without affecting its properties or performance.
   4. Conduit shall be of smooth wall construction.
   5. Manufacturers:
      a. Blue Diamond.
      b. Carlon
      c. or equal.
   6. Splice Couplings:
      a. The use of splice couplings shall be minimized by optimizing conduit usage between pull box and pole locations.
      b. Aluminum couplings or butt fusion couplings may be used in accordance with Manufacturer’s recommendations.
      c. Splice couplings must form a tight seal with a breaking force greater than 250 pounds.

I. Joint Compound for RMC or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

J. Conduit Hubs for RMC or IMC:
   1. Suitable for environment served.
   2. Grounding screw.
   3. O-ring gasket.
   4. Material: Malleable Iron with zinc electroplate.
   5. Manufacturers:
      a. Cooper Myers Hubs.
      b. Thomas & Betts.
      c. Killark.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install conduit products in accordance with:
   1. The Drawings.
   2. The Manufacturer's written instructions.

3. Applicable requirements of NFPA 70 and NECA 1.Recognized industry practices to ensure that products serve intended function.
4. Recognized industry practices to ensure that products serve intended function.

B. Unless otherwise specified or indicated on the Drawings, conceal conduit to the extent possible.
1. In finished areas where conduit cannot physically be concealed due to existing conditions, surface mount conduit. Finished areas are generally, but not always: above grade, heated spaces with finished walls (e.g., painted, drywall, etc.), finished floors (e.g., painted concrete, carpet, tile, etc.), and finished ceilings (e.g., drywall, suspended ceiling grids, wood, etc.).
2. Conduit shall not be concealed within tank walls, slabs, or ceilings.

C. Exposed conduit permitted in:
1. Tunnels.
2. Service equipment rooms.
3. Rooms without finished ceilings (overhead only).
4. Unfinished rooms.

D. General requirements for all conduits:
1. Conduit Joints: Cut square, reamed smooth and drawn up tight.
2. Threaded Conduit Joints: Apply listed anti-corrosion/anti-seize compound to threads of raceway and fittings before making up joint. Follow compound manufacturer's written instructions.
3. Bends:
   a. Number per run for conduit that support feeder and branch circuits: Do not exceed the equivalent of 4quarter bends (360 degrees) between pull points.
   b. Number per run for conduit that supports data/communications cabling: Do not exceed the equivalent of 2 quarter bends (180 degrees) between pull points.
   c. Make bends and offsets so as not to reduce the inner diameter of the conduit.
   d. To the extent possible, avoid using large junction boxes as 90 degree junctions.
4. Routing:
   a. Concealed Conduits: Run in a direct line with long sweep bends and offsets.
   b. Exposed Conduits: Run parallel to, and at right angles to, building lines.
   c. Run continuous from outlet to outlet and from outlets to cabinets, pull or junction boxes.
   d. Secure to boxes and cabinets with locknuts and bushings in such a manner that each system is electrically continuous throughout.
5. Cap conduit ends to prevent entrance of foreign materials during construction.
6. Provide insulated bushings on threaded conduit run terminations. Where entering the bottom of open-bottom equipment (i.e., switchboards, motor control centers, primary switches, transformers, or similar equipment) provide bonding bushings and bonding jumpers.
7. Where entering the bottom of open-bottom equipment (i.e., switchboards, motor control centers, primary switches, transformers, or similar equipment) conduit shall not be installed flush with the floor/equipment pad and shall not rise more than 3-inches above the bottom of the enclosure.
8. Conduit entering control panels shall not obstruct internal components and shall allow for neat and workmanlike wire management.
9. Completely install conduit systems before installing conductors.
10. Refer to Division 26 Section "Common Work Results for Electrical" for sealing underground and above grade conduit that is exposed to temperature differences to prevent the passage of air and condensation.
11. Support:
   a. Where information on Drawings conflicts with information herein, the more stringent requirements shall take precedence and the better quality or greater quantity of work shall be provided.
   b. Adequately support conduit from structural elements of the building.
   c. Do not drill or tap structural building steel without approval from Engineer.
   d. Do not rest raceways or wiring systems on, nor support it from, ceiling suspension systems, ceiling tiles or mechanical equipment including, but not necessarily limited to ductwork and fans.
   e. Conduit shall be supported in accordance with:
      1) NFPA 70.

2) Division 26 Section “Hangers and Supports for Electrical Systems”

12. Provide conduit expansion couplings where conduits cross building or structure expansion joints.
13. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200 pound (90 kg) tensile strength. Label and leave at least 12-inches of slack at each end of pull wire.

E. FMC and LTFMC Installation:
1. Provide separate grounding conductor in accordance with Division 26 Section “Grounding and Bonding.”
2. Connection to light fixtures shall not exceed 6-feet in length within an accessible ceiling and 3-feet in length where exposed. Connection to solenoids, pressure switches, motors, fans, HVAC equipment, and similar equipment shall not exceed 3-feet in length.
3. Flexible conduit shall not be used to connect to surface mounted light fixtures or other non-moving, non-vibrating, or non-adjustable equipment.

F. Rigid Nonmetallic Conduit Installation:
1. Provide separate grounding conductor in accordance with Division 26 Section “Grounding and Bonding.”
2. Support conduit in accordance with NFPA 70.
3. Provide expansion couplings where length change due to temperature variation exceeds 1/4-inch.
4. When penetrating concrete surfaces or grade, make a transition to rigid steel conduit 6-inches below the surface. Provide corrosion protection by coating the RMC with a bituminous coating from inside the encasing material to 4-inches of exposed conduit; vinyl corrosion protection tape may be installed, but must be reviewed with the Engineer prior to installation.
5. Provide rigid steel elbows in all conduit that is underground or encased in concrete.
6. In areas of assembly, where RNMC is installed, conduits shall be encased in a minimum of 2-inches of concrete.
7. Where RNMC is embedded in concrete, conduit shall be securely fastened and supported in accordance with NFPA 70 to prevent damage during concrete pours.

G. Firestopping
1. Firestop all conduit penetrations of fire rated barriers by using approved material to ensure integrity of the rating. See Division 26 Section "Common Work Results for Electrical".

H. Underground Installation:
1. Requirements below apply to conduit(s) not installed in a duct bank. For duct bank installation requirements see the Drawings and Division 26 Section "Underground Ducts And Raceways for Electrical Systems".
2. As indicated in herein and on the Drawings, including the excavating, pumping, backfilling, shoring and removal of surplus excavated material.
3. Underground Obstructions:
   a. Locate all that may interfere with excavation.
   b. Be responsible for damage to existing underground systems and assume all cost of repairing the same.
4. Backfilling:
   a. Use only clean sand thoroughly compacted to prevent settling of trenched areas.
   b. In the event that backfilled areas do settle, fill and compact to finish grade, and repair all damage caused by settling.
5. Repair all disturbed surface to match existing.
6. Unless otherwise indicated on the Drawings, install top of conduit 30-inches below grade when located outside the walls of the building
7. Provide warning ribbon with tracer wire 6-inches below grade directly above conduits, unless noted otherwise.

I. Embedment in Concrete:
1. Where conduit is embedded in concrete, follow the requirements of Section 6.3 in ACI CODE-318 and Section 6.3 in ACI 350-20.
2. Review proposed routing of embedded conduit with Engineer prior to installation.

3. Embedded conduit shall be installed between top and bottom reinforcement, in a manner that prevents concrete from entering the conduit system.

J. Data/communications Conduits:
1. Data/communication conduits shall be bonded.
2. Provide sleeves and plastic bushings for all conduits.

K. Lighting Fixture Conduits:
1. Light fixtures shall not be supported via standard locknuts at the fixture connection. Provide fittings with set-screw or other means to prevent loosening.
2. When pendant mounting:
   a. Hands-free swivel type hangers shall be used in dry locations.
   b. Threaded condulet fittings shall be used in Damp, Wet, Corrosive, and Hazardous Locations.

L. Provide separate raceway systems for:
1. Normal power wiring.
2. Emergency power wiring.
3. Data/communication wiring.
4. Fire alarm system wiring.
5. A.C. signal and control wiring.
6. Low voltage signal and control wiring.
7. Analog instrumentation wiring.
8. Special systems wiring.

M. Do not utilize panelboard, motor control centers, distribution equipment, or like equipment as raceways.

N. For conduits that enter NEMA Type 2, 3, 3R, 4, 4X, and 12 enclosures, provide conduit hubs with o-ring gaskets. Hubs shall be suitable for the environment served and shall match the conduit type. Grounding hubs shall be used with nonmetallic enclosures.

END OF SECTION

SECTION 26 05 35 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all electrical boxes and the major items listed below for:
   1. Outlet boxes.
   2. Junction boxes.
   3. Pull boxes.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. NEMA - National Electrical Manufacturer's Association: Standards as applicable to nonmetallic fittings for underground installation.
   2. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   3. NECA - National Electrical Contractor's Association's: Applicable portions of "Standard of Installation".

1.4 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Regulatory Agencies Requirements:
   1. Provide boxes which are listed and labeled by Underwriters' Laboratories.
   2. NFPA 70 - As applicable to construction and installation of electrical boxes.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer’s directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate wiring, devices, and equipment to be installed.
   2. All products shall be listed, classified, and labeled as suitable for intended use.
   3. Provide grounding terminals withing boxes where equipment grounding conductors terminate.

B. Outlet Box Schedule:
   1. In general box type should match the raceway type being served; galvanized steel boxes shall be used with galvanized steel rigid metal conduit; PVC boxes shall be used with RNMC conduit, PVC coated or fiberglass boxes shall be used with PVC coated RMC, etc.
   2. Dry Locations:
      a. Galvanized steel outlet boxes constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
   3. Damp or Wet Locations:
      a. Corrosion-resistant cast metal aluminum, weatherproof outlet boxes with threaded conduit ends.
   4. Nonmetallic Boxes:
      a. When providing boxes for use with RNMC, provide compatible nonmetallic boxes. Boxes to have conduit hubs with removable plugs and a non-metallic cover.

C. Outlet Box Minimum Sizing:
   1. Finished, Dry Spaces:
      a. Ceilings: 4-inch octagonal boxes for receiving 3 or less 1/2-inch conduits.
         1) Rated to support light fixtures or other equipment as required.
      b. Walls:
         1) 4-inch square boxes with matching plaster cover for single or 2 gang outlets.
         2) For larger boxes use solid type or special units.
         3) In masonry, use deep boxes.
      c. Surface Mounted: 4" square.
   2. Damp or Wet Spaces:
      a. Sized as required for equipment or devices indicated.

D. Outlet Box Accessories:
   1. As required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, gaskets, and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes being used and meet the requirements of individual wiring situations.
   2. Choice of accessories is installer's option and as required to maintain listings and meet NFPA 70 requirements.

E. Junction and Pull Box Schedule:
   1. In general box type should match the raceway type being served; galvanized steel boxes shall be used with galvanized steel rigid metal conduit; PVC boxes shall be used with RNMC conduit, PVC coated or fiberglass boxes shall be used with PVC coated RMC, etc.
   2. Dry Spaces:
      a. Galvanized sheet steel with screw-on covers with welded seams with stainless steel hardware (nuts, bolts, screws, washers, etc.).
   3. Damp and Wet Spaces:
      a. Galvanized or powder coated steel with gasketed cover. Screw on or clamped on cover as required for application. Stainless steel hardware (screw, clamps, etc.)
   4. When using flush mounted junction and pull boxes provide overlapping covers with flush-head cover retaining screws, prime coated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Size boxes as required to accommodate actual installed arrangement of conductors, clamps, support fitting, and devices. Sizes, when indicated, are minimum requirements. Sizing of all boxes shall be calculated according to NFPA 70 requirements.

B. Coordination:
   1. Coordinate the placement of boxes with millwork, furniture, devices, equipment, splash backs, etc. installed under other sections or by others. Adjust outlet mounting height or location to agree with required location for equipment served.
   2. Coordinate the work with other trades to preserve insulation integrity.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. General:
   1. Install electrical boxes as indicated, in compliance with NFPA 70 requirements and in accordance with the Manufacturer's written instructions and recognized industry practices to ensure that the boxes and fittings serve the intended purposes.
   2. Spaces exposed to weather or moisture are considered damp or wet locations, provide appropriate boxes per the schedules herein.
   3. Provide knockout closures to cap unused knockout holes where blanks have been removed.
   4. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
   5. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
   6. Adjust position of outlets in finished masonry walls to suit masonry course lines.
   7. Do not install boxes back-to-back in same wall. Coordinate cutting of masonry walls to achieve neat openings for boxes.
   8. Do not use sectional or handy boxes unless specifically indicated on the Drawings.
   9. For boxes mounted in exterior walls install insulation behind outlet boxes to prevent condensation in boxes.
   10. Outlet boxes in finished areas shall be located as indicated on the Drawings and so set that the face plates will be flush with the finish on which it is mounted. Where 2 or more devices of any kind are set side by side, set them in gang boxes unless otherwise noted on the Drawings. Finished areas are generally, but not always: above grade, heated spaces with finished walls (e.g., painted, drywall, etc.), finished floors (e.g., painted concrete, carpet, tile, etc.), and finished ceilings (e.g., drywall, suspended ceiling grids, wood, etc.).
   11. Outlet boxes in unfinished areas shall be located as indicated on the Drawings and surface mounted. Provide boxes and faceplates compatible with surface mounting. Unfinished areas are generally, but not always: mechanical rooms, electrical rooms, above ceilings, tunnels, rooms without a finished ceiling, process/pump/motor rooms.
   12. Locate pull boxes and junction boxes above removable ceilings or in electrical rooms, utility rooms, or storage areas such that boxes will be accessible after completion of building.
   13. All boxes shall have covers installed at completion of construction.

END OF SECTION

SECTION 26 05 36 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of steel, aluminum, fiberglass, and stainless steel cable trays,support systems, wall penetration assemblies, and accessories .

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. ASTM B766 - Standard Specification for Electrodeposited Coatings of Cadmium; 2023.

E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. NEMA BI 50015 - Metal Cable Tray Systems; 2024.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 568 - Nonmetallic Cable Tray Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Shop Drawings: For cable tray.
   1. Name of Manufacturer.
   2. Model numbers.
   3. Details of construction and installation.
   4. Equipment specifications and ratings.
   5. Dimensional data.
   6. Weight.
   7. Color and finish.

8. Bill of materials.
9. Options and accessories.

B. Layout Drawings: For cable tray. Plans shall be to scale and identify routing information, mounting elevations, support locations, and wall/floor penetrations.

C. Cable tray sizing calculations.

D. Installation instructions for cable tray

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70 .

B. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed submittals.

C. Regulatory Agencies Requirements:
1. Comply with applicable requirements of NEMA standards pertaining to raceways.
2. Comply with provisions of UL safety standards pertaining to electrical conduit systems.
3. All products and components shall be UL listed and labeled.
4. Comply with the NFPA 70 (NEC) requirements as applicable to construction and installation of cable tray systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage (e.g., bending, end damage, finish scoring), contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cable Tray, Fittings and Accessories:
1. ABB, Inc: www.new.abb.com/#sle.
2. Cablofil, a brand of Legrand North America, Inc.
3. Cope, a brand of Atkore International Inc.
4. B-Line Systems, Inc.
5. Chalfant Cable Trays.
6. GS Metals Corp.
7. Mono-Systems, Inc.
8. MPHusky.
9. P-W Industries, Inc.
10. Or equal.

11. Source Limitations: Furnish cable tray system and associated components and accessories produced by single manufacturer and obtained from single supplier.

B. Wall Penetration Assemblies:
   1. Weatherstop Penetrations (WSP) by CSD Sealing Systems.
   2. Or equal.

2.2 MATERIALS AND FINISHES

A. Cable trays, fittings and accessories shall be steel, with the following finish:
   1. Mill galvanized before fabrication, complying with ASTM A653/A653M, G90 coating.
   2. Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2.
   3. Epoxy-resin paint over paint Manufacturer's recommended primer and corrosion inhibiting treatment.
   4. Steel cable tray shall meet or exceed the requirements set forth in NEMA BI 50015.

B. Cable trays, fittings and accessories shall be aluminum, complying with Aluminum Association's alloy 6063-T6 for rails, rungs, and cable trays, and alloy 5052-H32 or alloy 6061-T6 for fabricated parts.
   1. Aluminum cable tray shall meet or exceed the requirements set forth in NEMA BI 50015.

C. Cable trays, fittings and accessories shall be stainless steel, Type 304.
   1. Stainless steel cable tray shall meet or exceed the requirements set forth in NEMA BI 50015.

D. Cable tray, fittings and accessories shall be fiberglass.
   1. Cable trays shall be furnished as a system including all necessary fasteners, hold-down clips, splice plates, support systems, barrier strips, covers, hinged horizontal and vertical splice plates, elbows, reducers, tees, crosses, etc.
   2. Splice plate fasteners shall be fiberglass encapsulated stainless steel. Fasteners shall be designed to prevent encroachment of liquids or vapors on the metal threads when fully assembled and tightened. Fasteners shall be capable of withstanding a torque of 10ft-lbs. without damage to the threads or encapsulated coating.
   3. Cable tray shall be of pultruded glass reinforced polyester resin. An ultraviolet stabilizer shall be incorporated in the resin formulation to inhibit ultraviolet degradation. Tray shall be weather-resistant, suitable for outdoor installation.
   4. Cable tray shall be of ladder type design having "E" or "Z" shaped side rails. Bottom plates shall be provided as required.
   5. Rungs shall be of the same material as the side rail and shall be secured in place to prevent roll-over when cables are pulled into the tray.
   6. Tray sections shall be 10 or 20 feet in length. Each straight section and fitting shall be furnished with prepunched holes to accept splice plate fasteners.
   7. Tray system design shall meet or exceed allowable working loads in accordance with UL 568.
   8. Tray loaded to the allowable working load shall be capable of supporting an additional 200 lb. concentrated static load at midspan without failure or permanent deflection.
   9. Tray system design shall meet all the requirements set forth in UL 568. Tray system design shall be tested by UL and be issued the appropriate certified UL listing.
   10. Flammability: Fire retardant with NFPA 101 , Class A flame spread index when tested in accordance with ASTM E84 ; self-extinguishing in accordance with ASTM D635 .

E. Protect steel hardware against corrosion by galvanizing according to ASTM B633 or cadmium plating according to ASTM B766.

F. Fabricate cable tray products with rounded edges and smooth surfaces.

G. Sizes and Configuration: Refer to the Drawings for specific requirements for types, materials, sizes, and configurations.

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray Manufacturer.

C. Wall penetration assemblies shall consist of 3 basic components: Galvanized steel frame, sponge rubber pads and sealant.
   1. Frames shall be attached to the wall to hold other components in place. Frames shall be able to be opened and closed repeatedly to allow for cable maintenance and additions.
   2. Sponge rubber pads shall be compressed around the penetrating items. Pads shall be able to be easily cut to fit around large cables, cable trays or ducting. Sponge shall provide a structural backing for the sealant.
   3. Sealant shall be a highly elastomeric silicon compound. Sealant shall be applied to the outer edge of the units. Sealant shall provide a water-and chemical-resistant barrier.
   4. Wall penetration assemblies shall be rated NEMA 4X.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cable tray products in accordance with:
   1. The Drawings.
   2. Manufacturer's written instructions.
   3. Applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation".
   4. Recognized industry practices to ensure that products serve intended function.

B. Support cable tray in accordance with:
   1. Division 26 Section “Hangers and Supports for Electrical Systems.”
   2. The NEC.

C. Coordinate installation with other trades.

D. Firestopping:
   1. Firestop all cable tray penetrations of fire rated barriers using approved material to ensure integrity of the rating.

END OF SECTION

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below for conduit duct banks:
   1. Manholes.
   2. Handholes.
   3. Pull boxes.
   4. Duct banks

1.3 SUBMITTALS

A. Shop Drawings:
   1. Manholes
   2. Handholes
   3. Pull boxes
   4. Requirements:
      a. Name of Manufacturer.
      b. Model number.
      c. Details of construction and installation.
      d. Assembly drawings, including elevations, plans, sections, dimensions, and weight.
      e. Bill of materials.
   5. Options and accessories.

B. Layout Drawings: For Manholes, Handholes, and Duct Banks shall be to scale and identify invert elevations where duct banks enter manholes and buildings:

1.4 QUALITY ASSURANCE

A. General: All concrete work including precast shall meet ACI Standards.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated material, and immediately remove from Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Conduit: As specified in Division 26 Section “Raceways for Electrical Systems.”

B. Precast Concrete Manholes and Handholes:
1. Hartford Concrete Products, Inc.
2. Advanced Concrete Products Company.
3. Bush Concrete Products, Inc.
4. Or equal.

C. Nonmetallic Pull Boxes:
1. Quazite - Hubbell Power Systems.
2. Oldcastle Precast Inc.
3. MacLean Highline Products.

D. Nonmetallic Cable Racks: Underground Devices, Inc.

2.2 MATERIALS

A. Precast Structures:
1. Manholes and Handholes: Sizes as indicated on Drawings.
2. Constructed of steel reinforced concrete.
3. With 30 inch heavy duty solid cast iron cover with riser casting as required. Cover to include lettering cast in top to identify conduit system served (i.e., ELECTRICAL, COMMUNICATIONS, TELEPHONE).
4. With conduit terminations sealed to prevent leakage around conduits. Conduit terminations to have bell ends.
5. With pull in irons opposite all duct entrances.
6. With cast in sump with 3/4-inch PVC sleeve and plug.
7. With vertical cable racks at 18 inches on center minimum on all sidewalls.
8. With copper ground bar. Bond all metal items in manhole to ground bar. Provide a driven ground rod outside each manhole and connect to ground bar.

B. Nonmetallic Pull Boxes:
1. Size in accordance with NEC for conduits entering.
2. Constructed of fiberglass reinforced polymer, rated for the environment they are installed in. (i.e., road ways, parking lots, green spaces, etc.
3. With heavy duty bolt down cover with lettering cast in top to identify conduit system served (i.e., ELECTRICAL, COMMUNICATIONS, TELEPHONE).
4. With conduit terminations sealed to prevent leakage around conduits.
5. With cast in sump.

C. Concrete: In accordance with Division 03 Section “Cast-in-Place Concrete.”

D. Earthwork: In accordance with Division 31 Section “Excavation and Fill for Utilities.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Underground Duct Banks:
1. Where underground conduits terminate at buildings, provide mechanical link seal to seal and make watertight all conduit penetrations into buildings.

2. Concrete Encased Duct Banks:
   a. Install top of duct banks a minimum of 24 inches below finished grade with plastic warning tape 6 inches below finished grade.
   b. Stagger conduit joints in concrete encasement at 6 inches minimum.
   c. Securely anchor conduit to prevent movement during concrete placement.
   d. Provide one No. 5 steel reinforcing bar in each corner of duct bank for full length of run. Steel shall comply with ASTM A615 with steel yield stress of 60,000 psi.
   e. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank. Use suitable separators and chairs installed not greater than 4 feet on center to provide 3-inch minimum conduit separation
   f. Provide 3,000 psi concrete.
3. Duct Banks Not Encased in Concrete:
   a. Install top of duct banks minimum 24 inches below finished grade with plastic warning tape 6inches below finished grade.
4. Install conduit with minimum gradient of 4 inches per 100 feet. Slope duct banks away from buildings to prevent drainage into the building.
5. Terminate conduits in end bells at manhole and handhole entries. Seal and make watertight around all conduit entries into manholes, handholes, and pull boxes.
   a. Securely anchor conduit to prevent movement during backfill placement.
   b. Provide clean sand backfill.
6. Where duct bank passes beneath footings or slabs resting on grade, excavate to provide a minimum of 6-inch clearance between the conduits and the structure. Backfill to the base of the structure with concrete.
7. Repair all disturbed surfaces to match original condition.

B. Manholes and Handholes:
   1. Over excavate and install on a minimum of 12 inches coarse aggregate.
   2. Set elevation as required to ensure duct drainage.
   3. Install in accordance with Manufacturer's instructions.
   4. Provide sealant at all joints.
   5. Train and tie all cables passing through structure to cable racks with plastic cable ties.
   6. Ground with #2 copper wire in accordance with Division 26 Section “Grounding and Bonding.”
   7. Repair all disturbed surfaces to match original condition.

C. Pull Boxes:
   1. Set top flush with grade.
   2. Over excavate and install on a minimum of 12-inch coarse aggregate
   3. Install in accordance with Manufacturer's instructions.
   4. Seal all conduit entries.
   5. Repair all disturbed surfaces to match original condition.

D. Concrete: In accordance with Division 03 Sections “Cast-in-Place Concrete.”

E. Earthwork: In accordance with Division 31 Section “Excavation and Fill for Utilities.”

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of proper identification for electrical system components.

B. Items requiring identification or labeling include:
   1. Cables and conductors.
   2. Conduit systems.
   3. Controls:
      a. Motor starters.
      b. Variable frequency drives.
      c. Lighting control relay panels.
      d. Lighting contactors.
   4. Distribution Equipment:
      a. Disconnect switches.
      b. Enclosed circuit breakers.
      c. Primary Switchgear
      d. Switchboards.
      e. Transformers.
      f. Panelboards.
      g. Motor control centers.
   5. High voltage equipment.
   6. Fire alarm system equipment.

1.3 SUBMITTALS

A. Nameplate schedule identifying each device to be labeled and project specific label text.

PART 2 - PRODUCTS

2.1 ELECTRICAL LABELS

A. Provide engraved laminated plastic nameplate to identify each piece of electrical equipment:
   1. Nameplate shall have 3/8-inch minimum black letters on a white background.
   2. Punched or drilled for mechanical fasteners.

B. Provide printed labels by Brady or T&B to identify conductors.

C. "DANGER - HIGH VOLTAGE KEEP OUT" signs shall be provided with white letters on a red background.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Attach nameplates directly to each piece of electrical equipment. In finished areas of building, install nameplates behind enclosure door where possible.
   2. Where several conductors pass through a pull box, junction box, or enclosure, provide wire labels. Group wires before labeling.
   3. Provide "DANGER - HIGH VOLTAGE KEEP OUT" signs on doors of all rooms containing equipment such as medium voltage switches, transformers, junction and pull boxes for medium voltage cables, and on medium voltage equipment mounted outdoors, such as pad-mounted transformers and switches.

B. Cables and Conductors:
   1. Cables and conductors shall be color-coded in accordance with Division 26 Section “Conductors and Cables – 600V and Below.”
   2. All conductors and cables for power, lighting, control, supervision, low voltage systems, etc. shall be labeled with the source and circuit number and/or match the identification provided in the manufacturer’s submittals and O&M manuals. If none of the identifiers are suitable or available, the Contractor shall devise a clear and understandable identification labeling system. Without exception, all cables and conductors shall be clearly labeled.
   3. Labeling shall occur everywhere cables and conductors are terminated or spliced.

C. Conduit Systems:
   1. Junction boxes used for fire alarm system wiring shall be red.
   2. Provide label inside each junction and pull box identifying circuit numbers for all conductors contained inside the box. Labeling shall be printed neatly with permanent, waterproof, black ink marker.

D. Controls: For each of the following control devices, provide label attached to enclosure cover. Label shall identify:
   1. Motor Starters: Name of equipment served and load (example, “EF-5, 5 HP).
   2. Variable Frequency Drives: Name of equipment served and load (example, “P-1, 25 HP”.
   3. Lighting Control Relay Panels:
      a. Name of device as indicated on relay panel riser diagram (example, “RP-1”).
      b. Equip interior of enclosure door with a circuit directory frame, typewritten card, and clear plastic cover. Directory shall identify load description for each circuit, including spares. Hand lettering is not acceptable.
   4. Lighting Contactors: Name of device and equipment served/controlled (example, “LC-1, Site Lighting”).

E. Distribution Equipment: For each of the following pieces of electrical distribution equipment, provide label attached to enclosure cover. Label shall identify:
   1. Disconnect Switches: Name of equipment served, number of poles, ampere rating/fuse size (where applicable), and load (example, “RTU-1, 3P30/25, 8 TON”).
   2. Enclosed Circuit Breakers: Name of device as indicated on one line diagram, number of poles, and circuit breaker size (example, “MCB, 3P200”).
   3. Primary Switchgear:
      a. Name of electrical equipment as indicated on one line diagram, voltage-phase, and source the switchgear is fed from (example, “PS1, 12.47Y/7.2kV-3Ø-4 WIRE, FED FROM UTILITY METERING ENCLOSURE”).
   4. Switchboards:
      a. Name of electrical equipment as indicated on one line diagram, voltage-phase, and source the switchboard is fed from (examples, “MSWBD, 480Y/277V-3Ø-4 WIRE, FED FROM T-MSWBD”; “T-MSWBD, 480Y/277V-3Ø -4 WIRE, FED FROM PS1”).

b. Provide label near each feeder/branch breaker identifying name of equipment served, number of poles, and circuit breaker size (example, “TRANSFORMER T-LPA, 3P80”).

5. Transformers: Name of electrical equipment as indicated on one line diagram, KVA rating, primary voltage:secondary voltage, source transformer is fed from, and load transformer feeds (example, “T-LPA, 45 KVA, 480:208Y/120V, FED FROM MSWBD, FEEDS PANEL LPA”).
6. Panelboards:
   a. Name of electrical equipment as indicated on one line diagram, voltage-phase, and source panelboard is fed from (examples, “LPA, 208Y/120V-3Ø-4 WIRE, FED FROM T-LPA”; “DPA, 480Y/277V-3Ø-4 WIRE, FED FROM MSWBD)”.
   b. Equip interior of enclosure door with a circuit directory frame, typewritten card, and clear plastic cover. Directory shall identify load description for each circuit, including spares. Hand lettering is not acceptable.
7. Motor Control Centers (MCCs):
   a. Name of electrical equipment as indicated on one line diagram, voltage-phase, and source MCC is fed from (example, “MCC-1, 480V-3Ø-4 WIRE, FED FROM MSWBD”).
   b. Provide label on each MCC compartment identifying type of device, device rating, load served, and load characteristics (examples, “MOTOR STARTER, SIZE 1, P-1, 10 HP or CIRCUIT BREAKER, 3P20, HOIST, 1 TON”). Provide labels for spare devices and spaces.

F. Fire Alarm System Equipment: Provide label attached to enclosure cover. Label shall identify name of device as indicated on fire alarm system riser diagram or electrical drawings (example, “FIRE ALARM CONTROL PANEL”).

END OF SECTION

SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY AND ARC FLASH RISK ASSESSMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for performing a computer-based, short circuit and protective device evaluation, selective coordination study for emergency and legally required standby power systems, and arc flash risk assessment.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).
   2. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   3. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

1.4 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Credentials of the subcontractor that is performing the study.

C. A preliminary draft study shall be submitted prior to releasing the electrical gear that is included in the study for manufacturing to ensure all equipment is properly rated for the available fault current. Conductor lengths may be scaled from the drawings.

D. A final study shall be submitted with the O&M manual that includes as-installed conditions, and all modifications to the systems during the construction process.

E. Short circuit and protective device evaluation, coordination study, and arc flash risk assessment:
   1. Submit a comprehensive list of each type of equipment proposed to be included in the study for review and approval by Engineer prior to execution of the study.
   2. Include copies of all project-specific arc flash hazard warning labels and 1 sample label for review and approval by Engineer.

F. Record of Final Low Voltage Circuit Protective Device Settings:
   1. Typewritten, bound in notebook form.
   2. Submit 2 hard copies.

G. Software Files:
   1. At the end of the project, provide all software files for project to Owner for their use. Provide all files as required for Owner to rerun studies in the future.

2. Owner shall have exclusive, irrevocable, world-wide, and royalty free rights to all the files.
3. Provide files to the Owner on a flash drive and as a zip file emailed to Owner's desired representative.

1.5 QUALITY ASSURANCE

A. Short circuit and protective device evaluation, coordination study, and arc flash risk assessment Subcontractor:
1. Study to be performed by a Subcontractor that is currently involved in high-voltage, medium-voltage, and low-voltage power system evaluations.
2. The Subcontractor shall have a minimum of 5 years of experience in power system evaluations.
3. Individuals performing the study shall be registered as a Professional Engineers in the state where the Project is located.

1.6 DATA COLLECTION FOR SHORT CIRCUIT AND PROTECTIVE DEVICE EVALUATION, COORDINATION STUDY, AND ARC FLASH RISK ASSESSMENT

A. Contractor Responsibilities: Provide all required data for preparation of the short circuit and protective device evaluation, coordination of study, and arc flash risk assessment. Field verify existing distribution systems to obtain all required data.

B. Subcontractor Responsibilities: Provide a listing of all required data necessary to perform the short circuit and protective device evaluation, coordination study, and arc flash risk assessment immediately after award of the Contract.

1.7 SOFTWARE

A. The software used to complete the studies and assessments shall be SKM Power*Tools. The latest version available.

B. The Owner does not require any software or licensing. Contractor or subcontractor shall hold their own license for software required to be used on the project.

PART 2 - PRODUCTS

2.1 SHORT CIRCUIT AND PROTECTIVE DEVICE EVALUATION, COORDINATION STUDY, AND ARC FLASH RISK ASSESSMENT

A. The Study shall include:
1. Each portion of the electrical distribution system from the normal and standby or emergency power sources down to, and including, the smallest adjustable trip circuit breaker in the distribution system.

2. The study shall include, but shall not be limited to, the following equipment:
a. Main Switchboard MSWBD.
b. Transformer T-LPA.
c. Panel LPA.
d. Motor Control Center MCC-1.
3. The study shall evaluate all system configurations (normal connections, emergency connections, tie breaker/switches opened or closed, etc.) to determine maximum fault conditions.

B. Short Circuit Current Study:

1. Provide calculation methods and assumptions, base per-unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and a tabulation of calculation results, conclusions, and recommendations.
2. Calculate short circuit interrupting and momentary duties (as applicable) for an assumed 3-phase bolted fault at the service entrance disconnecting means, each switchboard, each motor control center, each distribution panelboard, and other significant locations throughout the distribution system.
3. Include fault contributions of each motor, unless specified otherwise.

C. Protective Device Coordination Study:
1. Provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms.
2. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Utilize different colors as necessary to clearly distinguish devices.
3. Include a detailed description of each protective device identifying its type, function, Manufacturer, and time current characteristics.
4. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
5. Include on the curve sheet, as applicable, power company relay and fuse characteristics, medium-voltage equipment relay and fuse characteristics, pertinent transformer characteristics, and pertinent motor and generator characteristics.
6. The study shall include all devices down to the largest branch/feeder circuit in each motor control center and distribution panelboard, and all adjustable settings for ground fault protective devices.

D. Selective Coordination Study for Emergency and Legally Required Standby Power Systems:
1. Provide confirmation of selective coordination of all overcurrent devices associated with supplying utility and generator to emergency loads in accordance with all applicable requirements of NEC Article 100 and Paragraphs 700.28 and 701.27. Study shall be based on coordination to 0.1 seconds. Study shall be based on the actual electrical equipment and overcurrent protective devices being submitted for the project.
2. Time-current coordination plots shall be made on log-log sheets or equivalent software generated plots and shall graphically indicate the coordination proposed for all the key systems. The plots shall include complete titles, one-line diagram and legend. Circuit breakers shall indicate manufacturer and type and have instantaneous, short delay, long-time pick-up and ground fault trip settings and ground fault ampere and time delay settings identified as plotted. Sensor or monitor rating shall be stated for each circuit breaker. All regions of the circuit breaker curve shall be identified. Circuit breaker curves shall include complete operating bands, terminating with the appropriate available short circuit current.

E. Arc Flash Risk Assessment:
1. Determine arc flash boundary, limited approach boundary, restricted approach boundary, and incident energy at all 3 boundaries for electrical distribution equipment required to be field marked in accordance with Article 110.16 of the National Electrical Code.
2. Calculations to be developed based on IEEE 1584.
3. Provide arc flash hazard warning labels for all electrical equipment included in the Study. Label information shall include all information as required by the Codes and Standards listed herein, and information including, but not limited to, the nominal system voltage, all 3 boundary distances, and the incident energy at each boundary. If arc flash reduction technologies are incorporated with the equipment, the reduced incident energy at each boundary shall also be included.
4. Electrical equipment with multiple sections and/or front and rear access, shall have labels installed on every section and/or both front and rear access panels.

F. Circuit Protective Devices: Notify Engineer in writing of circuit protective devices not properly rated for the available fault conditions.

G. Phase and Ground Coordination:

1. Include coordination of the generator protective devices.
2. Show the generator decrement curve and damage curve along with the operating characteristics of the protective devices.
3. Obtain information from the generator Manufacturer and include the actual generator impedance, time constraints, and current boost data.
4. Do not use typical values for the generator.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install arc flash hazard warning labels on all electrical equipment, included in the Study, with all the required information indicated herein.

B. Contractor shall perform field adjustments of protective devices and replace fuses as required to place the equipment in final operating condition. Settings for protective devices, fuse types and fuse sizes shall be in accordance with the recommendations of the reviewed coordination study.

END OF SECTION

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Refer to Division 01 Section "General Commissioning Requirements" for detailed explanation of commissioning work. Section also contains sample Cx Plan, construction checklist, and functional test.

1.2 SUMMARY

A. This Section lists electrical systems to be commissioned. The commissioning process is described in detail in the commissioning plan (Refer to Division 01 Section “General Commissioning Requirements”).

1.3 SYSTEMS TO BE COMMISSIONED

A. The following systems will be commissioned:
1. Medium Voltage Cables.
2. Conductors and Cables 600V and below.
3. Grounding and Bonding.
4. Overcurrent Protective Device Coordination Study.
5. Lighting Control Devices.
6. Lighting Control/Dimming Systems.
7. Padmount, Liquid Filled, Medium Voltage Transformers.
8. Medium Voltage Switchgear.
9. Low Voltage Distribution Transformers.
10. Switchboards.
11. Panelboards.
12. Motor Control Centers.
13. Wiring Devices.
14. Low Voltage Circuit Protective Devices.
15. Enclosed Switches.
16. Enclosed Controllers.
17. Variable Frequency Motor Controllers.
18. Engine Generators.
19. Central Battery Equipment.
20. Static Uninterruptible Power Supply (UPS).
21. Automatic Transfer Switches.
22. Surge Protective Devices.
23. Lighting.
24. Fire Detection and Alarm.
25. Access Control Systems.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 NOT USED.

END OF SECTION

SECTION 26 08 13 - ELECTRICAL ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electrical testing.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
   2. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   3. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
   4. IEEE - Institute of Electrical and Electronics Engineers.

1.4 SUBMITTALS

A. Within 30 days after Notice to Proceed, submit certification of the qualifications of the Electrical Testing Firm (ETF).

B. Within 30 days after Notice to Proceed, submit a complete project-specific list (based on project-specific nomenclature), of all equipment to be tested and the descriptions of the tests to be performed, for approval.

C. For items to be tested, a test report shall be generated for each piece of electrical equipment, device, installation and system as indicated in the Specifications and shall include the following:
   1. Check list of visual and mechanical inspections.
   2. Check list of electrical tests performed.
   3. Test reports, including test values where applicable, for all required electrical tests.
   4. Obvious indication on the first page of the test report, where test results fall outside of the limits of recommended values.
   5. Summary and interpretation of test results.
      a. Describe the problem in detail.
      b. Offer suggestions for correction or potential solution.
   6. Signed and dated by the testing firm stating that all required tests have been completed.

D. Test reports shall be furnished to the Architect/Engineer within 14 days of completion of each test on an ongoing basis for approval. Final copies of the approved reports shall be included in the Contractor's Operation and Maintenance (O&M) Manual.

E. Submit a final report of testing and inspection at the completion of the project. Include the following:
   1. Summary of the project.
   2. Description of the equipment tested (based on project-specific nomenclature for all applicable equipment).

3. Visual and mechanical inspection report for each piece of equipment.
   a. Report shall include a clear statement or verbiage that all visual and mechanical inspections have been performed in accordance with the NETA guidelines for all equipment and or items listed in the approved Submittal of a project specific list indicated in paragraph 1.4 B.
4. Description of the NETA required electrical tests.
5. Test results as described in the latest edition of NETA.
   a. Include a pass or fail grade as compared to the reference tables provided in ANSI/NETA ATS-(Latest Edition) and industry standards for all individual tests.
   b. Report shall include all test results. This includes all failed tests and retests.
   c. Infrared report shall include all pictures taken of all equipment, not just equipment with issues. If issues are found, the report shall include a picture of the issue and a picture after the problem has been resolved.
6. Conclusions and recommendations.
7. Appendix including appropriate test forms.
8. Identification of the test equipment used, including model number, and calibration date.
9. Signature of test engineer.

1.5 QUALITY ASSURANCE

A. The ETF shall be a corporately and financially independent NETA certified testing organization.

B. The ETF shall function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm unless the ETF indicated above allows the installing contractor to perform the testing.

C. The ETF shall be regularly engaged for minimum of 5 years in testing of electrical materials, devices, electrical installations, and systems for purpose of preventing injury to persons or damage to property and other equipment

D. The ETF shall have successfully completed not less than 5 acceptance testing, inspection and calibration projects of similar scope to this Project.

E. The ETF shall meet OSHA criteria for accreditation of testing laboratories, 29 CFR Parts 1907, 1910, and 1936, or be a Full Member company of NETA (unless paragraph 1.5 A allows the installing contractor to perform the testing).

F. The ETF lead, on-site, technical person shall be currently certified by NETA or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing, unless paragraph 1.5 A allows the installing contractor to perform the testing.

G. The ETF shall only utilize engineers and technicians who are regularly employed by the firm for testing services.

H. The ETF shall have a calibration program to maintain applicable test instrumentation within rated accuracy. Accuracy shall be traceable to National Institute of Standards and Technology (NIST) in an unbroken chain. Instruments shall be calibrated as follows:
   1. Field Instruments: 6 months maximum.
   2. Laboratory Instruments: 12 months maximum.
   3. Specialty Leased Equipment: 12 months maximum.
   4. Dated calibration labels shall be visible on test equipment.

I. Submit certification of the above qualifications; refer to the SUBMITTALS Paragraph of this Section.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 VISUAL INSPECTIONS

A. The ETF shall perform all visual and mechanical inspections in accordance with ANSI/NETA ATS-(Latest Edition) “Testing and Test Procedures” chapters in addition to the list below for all applicable electrical equipment to be installed at the Site.

B. The ETF prior to testing, shall perform the following visual and mechanical inspections (in addition to the NETA requirements listed above).:
   1. The equipment is installed in accordance with manufacturer’s installation instructions and NFPA 70 (NEC).
   2. The equipment is installed completely and properly.
   3. The equipment is free from damage and defects.
   4. Shipping blocks and restraints have been removed.
   5. Electrical terminations have been properly torqued to manufacturer’s recommendations and torque marks applied.
   6. The equipment has been properly aligned.
   7. The equipment has been properly lubricated.
   8. The ventilation louvers are open and unobstructed.
   9. The equipment is ready to be tested.

3.2 TEST PROCEDURES

A. Many electrical tests will need to be performed prior to making terminations and connections and ahead of system start-up. The electrical contractor is required to coordinate this work with all parties involved to avoid delays in construction or obtaining permanent power.

B. The ETF shall perform all test procedures on-site, no exceptions allowed. It will not be acceptable to remove equipment or components and ship items off-site to be tested then ship items back to the site to be reinstalled.

C. All disassembly and reassembly of equipment for testing purposes shall be performed or witnessed by the approved testing agency.

D. The ETF shall perform test procedures in accordance ANSI/NETA ATS-(Latest Edition) “Inspection and Test Procedures” chapters (see list below; not all may be applicable for this project) for all applicable electrical equipment to be installed at the Site.
   1. 7. INSPECTION AND TEST PROCEDURES.
      a. 7.1 Switchgear and Switchboard Assemblies.
      b. 7.2.1.1 Transformers, Dry-Type, Air-Cooled, Low-Voltage, Small. Test all dry type transformers 75kVA and above.
      c. 7.2.1.2 Transformers, Dry-Type, Air-Cooled, Large.
      d. 7.2.2 Transformers, Liquid-Filled.
      e. 7.3.2 Cables, Low-Voltage, 600-Volt Maximum. Test all cables 100A and above.
      f. 7.3.3 Cables, Medium- and High-Voltage. Test all medium voltage cables using VLF and Tan Delta testing.
      g. 7.5.1.2 Switches, Air, Medium-Voltage, Metal-Enclosed.

h. 7.6.1.1 Circuit Breakers, Air, Insulated-Case/Molded-Case.Circuit breakers part of a manufacturer's packaged system to be NETA tested at factory by manufacturer. Submit all NETA testing documentation from manufacturer.
i. 7.6.1.2 Circuit Breakers, Air, Low-Voltage Power. Circuit breakers part of a manufacturer's packaged system to be NETA tested at factory by manufacturer. Submit all NETA testing documentation from manufacturer.
j. 7.6.1.3 Circuit Breakers, Air, Medium-Voltage.
k. 7.9.2 Protective Relays, Microprocessor-Based.
l. 7.11.2 Metering Devices, Microprocessor-Based.
m. 7.13 Grounding Systems.
n. 7.14 Ground-Fault Protection Systems, Low-Voltage.
o. 7.15.1 Rotating Machinery, AC Induction Motors and Generators. Test all individual motors 10 HP and above that are not a part of manufacturer’s packaged systems.
p. 7.15.2 Rotating Machinery, Synchronous Motors and Generators.
q. 7.15.3 Rotating Machinery, DC Motors and Generators. Test all individual motors (regardless of type) 10 HP and above that are not a part of manufacturer's packaged systems.
r. 7.16.1.1 Motor Control, Motor Starters, Low-Voltage.
s. 7.16.2.1 Motor Control, Motor Control Centers, Low-Voltage.
t. 7.17 Adjustable Speed Drive Systems.
u. 7.19.1 Surge Arresters, Low-Voltage.
v. 7.22.1 Emergency Systems, Engine Generator.
w. 7.22.2 Emergency Systems, Uninterruptible Power Systems.
x. 7.22.3 Emergency Systems, Automatic Transfer Switches.
y. 7.24.1 Automatic Circuit Reclosers and Line Sectionalizers,
z. 7.25 Fiber-Optic Cables.
aa. THERMOGRAPHIC SURVEY
    1) Equipment that requires thermographic survey, includes but is not necessarily limited to Within 30 days after Notice to Proceed, submit a complete project-specific list (based on project-specific nomenclature), of all equipment to be tested for approval.
        (a) Low Voltage switchgear.
        (b) Medium voltage switchgear
        (c) Motor control centers.
        (d) Switchboards.
        (e) Panelboards.
        (f) Liquid-filled transformers.
        (g) Dry-type transformers.
        (h) Low voltage cables.
        (i) Medium voltage cables.
        (j) Switches.
        (k) Circuit Breakers.
        (l) Metering devices.
        (m) Motor controllers.
        (n) Variable speed controllers.
        (o) Engine generator emergency system.
        (p) Transfer switches.
        (q) Etc.

3.3 CORRECTION ACTION

A. Equipment that fails a test shall be repaired or replaced as needed and retested. Both the failed test and the passing test shall be submitted for approval and included in the contractors O&M Manual. For failed test, add note to refer to follow-up test.

END OF SECTION

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all lighting control devices listed below:
   1. Occupancy sensors and related power packs.
   2. Photocells (outdoor).
   3. Photo sensors (daylight harvesting).
   4. Time clocks.
   5. Emergency Lighting Relay, UL 924 device.

1.3 SUBMITTALS

A. Shop Drawings: Provide the following information for each type of lighting control device.
   1. Name of Manufacturer.
   2. Model number.
   3. Details of construction and installation.
   4. Assembly drawings, including elevations, plans, sections, and dimensions.
   5. Project Specific Point-To-Point Wiring Diagrams:
      a. Diagrams shall clearly identify all field wiring requirements.
      b. Connection points shall be identified by terminal number.
   6. Project specific floor plans, including all occupancy sensor types and locations as recommended by Manufacturer
   7. Project specific floor plans, including all photo sensor types and (daylight harvesting) locations as recommended by Manufacturer.
   8. Color and finish.
   9. Options and accessories.

B. Installation Instructions: For lighting control devices.

C. Installation and Maintenance Manuals: For lighting control devices.
   1. Equipment function, normal operating characteristics, and limiting conditions.
   2. Assembly, installation, alignment, adjustment, and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
   4. Maintenance instructions.
   5. Guide to “troubleshooting.”
   6. Parts list and predicted life of parts subject to wear.
   7. Project specific outline and cross-sections, assembly drawings, engineering data, and wiring diagrams. Wiring diagrams shall reflect final, as-installed conditions and include wire numbers.
   8. Test data and performance curves.

1.4 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Manufacturer:
   1. At least 5 years experience with approved systems.
   2. Provide Owner training on system operation.

C. Components: All equipment shall be UL listed.

1.5 WARRANTY

A. In accordance with the warranty provisions defined in the General Conditions and Supplementary Conditions: Includes all lighting control systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected material with new material at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Furnish and install lighting control devices as indicated on the Drawings.

B. Line Voltage Wiring: No. 12 AWG minimum.

C. Low Voltage Wiring:
   1. For low voltage wiring, provide wire type as recommended by the Manufacturer.
   2. Adhere to manufacturer's recommendations as to maximum wire length and maximum quantity of relays per switch.

D. Provide devices in the quantity and locations as indicated on the drawings.

E. Provide wiring as indicated in wiring diagrams on the Drawings.

2.2 OCCUPANCY SENSORS:

A. Provide occupancy sensors as indicated herein and on the Drawings.
   1. System Components:
      a. Ultrasonic occupancy sensors.
      b. Passive infrared occupancy sensors.
      c. Dual technology occupancy sensors.
      d. All Occupancy Sensors Shall Include:
         1) Self adjusting type based on algorithm for maximum performance Adjustable time delay 30 seconds to 15 minutes
         2) Adjustable unit sensitivity.
         3) UL and CBA listed.
         4) Five year warranty.

5) Mounting brackets or boxes as required for each space application.

e. Each Ceiling Mounted Sensor Shall Include:
   1) Power pack and/or slave packs as required
   2) Isolated relay contact.
   3) Manual off override if indicated.
   4) LED indicates motion detection.

B. Manufacturer:
   1. All occupancy sensors shall be produced by the same Manufacturer.
   2. Leviton.
   3. Lutron.
   4. Wattstopper.
   5. Acuity.
   6. Greengate

2.3 PHOTOCELLS (OUTDOOR):

A. Provide photocells to be used as an input to the lighting control system.

B. Photocells shall be compatible with lighting control system to be used.

C. Manufacturer:
   1. All photocells shall be produced by the same Manufacturer.
      a. Intermatic.P
      b. Paragon.
      c. Tork.

2.4 PHOTO SENSORS (DAYLIGHT HARVESTING):

A. Provide photo sensors (daylight harvesting) to be used as an input to the lighting control/dimming system.
   1. Photocells shall be compatible with lighting control system to be used.

B. Manufacturer:
   1. All occupancy sensors shall be produced by the same Manufacturer.
   2. Leviton.
   3. Lutron.
   4. Wattstopper.
   5. Acuity.
   6. Greengate

2.5 TIMECLOCK:

A. Provide programmable 7-day time clock capable of maintaining schedule with the following features.
   1. Electronic. Analog.
   2. Astronomical.
   3. Timer automatically adjusts to correct time after power outage.
   4. Local manual override switch
   5. Self adjusting timer for seasonal changes.
   6. Battery back-up to maintain time control and schedule.
   7. Enclosure type shall be NEMA 1

B. Manufacturer:
   1. All time clocks shall be produced by the same manufacturer.
   2. Intermatic.
   3. Paragon.
   4. Tork.

2.6 EMERGENCY LIGHTING RELAY, UL 924 DEVICE:

A. Ballast load transfer control relay device shall operate as follows:
   1. Unit shall comply with NEC and UL924.
   2. Unit operates automatically on a continuous standby mode.
   3. Unit bypasses any electrical control device.
   4. Unit switches load to back-up power when normal power fails with no possibility of current crossover.
   5. Failsafe operation.
   6. Contacts shall be rated for 16 Amps ballast load.
   7. Instantaneous operation Unit shall be equipped with time delay operation
   8. Test switch.
   9. LED indicators for normal/emergency mode.
   10. Unit shall be capable to isolate catastrophic faults internally or external of unit.
   11. Unit shall be equipped with surge protection.

B. Manufacturer:
   1. All emergency lighting relays shall be produced by the same manufacturer.
      a. Leviton.
      b. Lutron.
      c. Wattstopper.
      d. Acuity.
      e. Greengate

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install lighting control devices as indicated on the Drawings.
   2. Install all lighting control devices in accordance with Manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. Contractor Field Service: Provide qualified personnel to perform, schedule and coordinate the following work:
   1. Before beginning work, contact Owner’s Building Automation System Contractor to review system requirements.
   2. Coordinate all work with Owner’s Building Automation System Contractor. Communicate any wiring revisions made in the field.
   3. Install all wiring, override switches, lighting control panels and contactors as indicated on Drawings.
   4. Terminate and label all wiring.
   5. Provide labels for all override switches, lighting control panels, and contactors.

3.3 CLEANING

A. Clean all lighting control system devices at Substantial Completion.

3.4 ADJUSTING

A. Set time delay and sensitivity for all occupancy sensors in accordance with Manufacturer’s written instructions based on room type.

B. Install photocells (outdoor) for northern exposure where possible.

C. Adjust settings as required for all photo sensors (daylight harvesting) for system to function properly and to maximize system performance.

D. Program time clocks with input from Owner.

E. For each room/area with a ballast load transfer control relay device, simulate a power outage and test each device to ensure unit is functioning properly and appropriate loads are switched. Make adjustments as required.

END OF SECTION

SECTION 26 09 30 - LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all lighting control systems as indicated on the Drawings and specified herein.

B. Lighting control systems shall consist of the following types of control panels or features:
   1. Programmable relay panel(s).
      a. Multiple panels shall be capable of being interconnected using twisted pair media (Ethernet).
      b. All relay panel interiors shall be pre-assembled complete with the necessary relays, transformers and devices. Relay panels that are wall mounted shall have interiors separate from enclosure so as to permit easy mounting, conduit installation and wire pull to enclosures.
   2. Networking:
      a. System shall be able to operate as a stand-alone entity with the option of using a web server device so that programming and viewing of status can be accomplished by any PC connected to the same LAN or via the internet.
      b. System shall be capable of being integrated with a building automation system. Where indicated herein or on the Drawings, System Supplier shall coordinate communication requirements with new and/or existing building automation system.
      c. Daylight harvesting capabilities.
      d. Dimming capabilities.
      e. Occupancy and/or vacancy sensing capabilities.
      f. Lighting control switches and/or stations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Lighting control system, including all panels, photosensors, occupancy/vacancy sensors, power packs, switches, control stations, etc., shall be by a single manufacturer:
   1. Wattstopper.
   2. Acuity nLight.
   3. Cooper Greengate.
   4. Or equal.

2.2 MATERIALS

A. General: Furnish and install all lighting control systems as indicated on the Drawings and in accordance with Manufacturer's installation instructions.

B. Room Controllers/Relays:
   1. Lighting Control Relays: Mechanically latching and shall come complete with a manual ON/OFF switch. The mechanical switch shall continuously display the true state of the relay’s internal contacts.

a. Single Pole Relays: Rated and UL/CSA listed for 120, 277and 347 VAC lighting loads at 20amps.
b. Double Pole Relays: Rated and UL listed for 208, 240 or 480 VAC and CSA for up to 347VAC lighting loads at 20 amps.

2. Shall have a label indicating the short circuit fault current rating in accordance with NEC2005. The relays shall have passed UL 508 short circuit tests at 14,000 amperes.
3. Each lighting control relay shall be capable of controlling incandescent, fluorescent, electronic ballast and H.I.D. lighting loads and have an inrush capability of 3,000 amperes.
4. Lighting Control Relays: Include captive screw terminals for both the line voltage and the low voltage connections. Switching the relay shall be accomplished with 1 signal wire and a common return. The signal wire shall be able to signal ON and OFF, and shall carry status current that indicates if the relay is ON or OFF.

C. Pre-assembled Relay Panels:
1. Where indicated on the Drawings, provide factory pre-assembled relay panels. The panel enclosures shall be for surface installation.
2. Provide a screw-on cover or a hinged door assembly as required.
3. The panel shall consist of a pre-assembled interior insert; UL/CSA approved with capacities for 12, 24, 36, 48, or 72 relays as required. Panel enclosure must be UL/CSA approved.
4. Panel interior shall have the following pre-assembled and pre-wired components:
a. Suitable divider separating Class 1 and Class 2 compartments.
b. Control transformer, UL/CSA approved for Class 2 circuits.
c. Low voltage relays as required by switched circuits indicated on Drawings or schedules.
d. Control devices as required.

D. Relay Controls Installed in Relay Panels:
1. When groups of relays are to be switched by master switches or time controls and it still must be possible to switch individual relays by local switches, provide programmable relay scanner.
2. Each scanner shall be solid state and have 24 relay outputs. An output shall be capable of switching the connected relay ON and OFF and sensing if the connected relay is ON or OFF.
3. Each programmable relay scanner shall have 5 switch inputs to accommodate group switches. Each switch input can be set with the keypad built into the scanner to switch some or all of the 24 relay outputs of the scanner. Each switch input must indicate an ON state if any of the relays in the group is ON. If all relays are OFF, then indicate an OFF state to the group switch.
4. The scanner shall be able to provide an optional flick warn option for each of the 5 groups. After the flick warn, the occupant has 5 minutes to prevent the local lights from switching OFF by activating the local switch.
5. The scanner shall provide an optional time-out option. When activated, this option will allow any relay in the system when switched on, to be timed for a 2 hour interval before being switched off. Flick warn may also be added to this option.
6. The programming of the scanner shall be user friendly with instructions printed on the scanner label.
7. The relay scanner shall accept a plug-in module, network node. The network node shall use a networking platform. This node shall be capable of connecting to a data line to communicate with other scanners in different relay panels or with other vendors using networking platform technology.

E. Relay Panel Network and Networking Platform Technology:

F. Control Stations (Switches) and Accessories:
1. 2-Wire Switches:
a. Remote control switches and switch hardware shall mount to standard wall boxes.
b. Switch modules shall be available with 1, 2, 3, or 4 switches per gang and shall fit into standard ‘Decora’ style switch plates. See Drawings.
c. Individual switches shall include an integral LED to indicate both ON and OFF states (red=ON, green=OFF). Switches can be connected directly to relays or to system switch inputs.
d. Each switch shall be clearly identified with a paper switch label. The label shall be held in place with a clear plastic cap and shall be field replaceable should the operation of the switch change. Permanently etched switches are not acceptable.
e. Switches shall have color coded captive screw terminals. Use #18 AWG solid conductors.

2. 0-10V Dimming Ballast Control Switches:
   a. Dimming control switches shall be compatible with dimming ballasts using the 0-10V control protocol. Coordinate exact requirements with ballast Manufacturer.
   b. An LED indicator bar shall display the proportional level of the connected ballasts.
   c. UP and DOWN buttons shall permit the operator to raise and lower the light level as required.
   d. Each switch shall be capable of controlling up to 50 dimming ballasts.
3. Switch Plates:
   a. Select switch plates to suit number of switches as indicated on Drawings. Up to 4 switches can be installed per gang box.
   b. Stainless steel switch plates shall be WN-974xx series.
   c. Plastic switch plates shall be screw-less and shall be white in color. Use WN-803xx-SW series.

G. Relay Panels and Conduit: Ensure that conduit for line voltage wiring enters panel in line voltage areas and conduit for low voltage control wires enters panel in low voltage areas. Check Manufacturer's drawings for location of line and low voltage areas.

H. Low Voltage Wiring:
   1. For low voltage wiring, provide wire type as recommended by the Manufacturer.
   2. Adhere to Manufacturer's recommendations as to maximum wire length and maximum quantity of relays per switch.
   3. Data line shall be #16 twisted pair Belden #8471; or equal. Data line switches require 2 pair #16 Belden #8472; or equal.
   4. Line Voltage Wiring: Use wire gauges from #12AWG to #14AWG as appropriately sized for the branch circuit.

I. Control Stations.

J. Systems Integrated With Building Automation System Using Network Platform: Provide interface connection to Building Automation System

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install lighting control / dimming systems as indicated on the Drawings.
   2. Obtain approval of Engineer for all changes in layout required to avoid interferences with other trades.
   3. Install all lighting control / dimming systems in accordance with Manufacturer's recommendations.
   4. Provide 120 volt input power for each lighting control / dimming panel as indicated on Drawings.

3.2 FIELD QUALITY CONTROL

A. Contractor Field Service: Provide qualified personnel to perform, schedule and coordinate the following work:
   1. Before beginning work, contact Owner's Building Automation System Contractor to review system requirements.
   2. Coordinate all work with Owner's Building Automation System Contractor. Communicate any wiring revisions made in the field.
   3. Install all wiring, control stations, override switches, lighting control panels and related electrical equipment as indicated on Drawings.
   4. Terminate and label all wiring.
   5. Provide labels for all control stations, override switches, lighting control panels and related equipment.

B. Assist Owner's Building Automation System Contractor in start-up:
   1. Inspect equipment for signs of damage.
   2. Verify installation is in accordance with Drawings.
   3. Test all switches, control panels and related equipment to be certain system will function properly.
   4. Demonstrate operation and maintenance to Owner's personnel.
   5. Provide 2 hour training sessions to Owner's personnel during each Site visit.
   6. Correct any deficiencies and make adjustments as required.
   7. Provide 2 separate Site visits for start-up. Schedule and coordinate date with Owner's Temperature Control System Contractor. Each Site visit shall be a minimum of 8 hours for the following:
      a. Site Visit No. 1 shall occur for system start-up.
      b. Site Visit No. 2 shall occur 3 to 4 months after building grand opening for final adjustments and additional training.

3.3 CLEANING

A. Clean all lighting control / dimming system equipment at Substantial Completion.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all distribution panelboards, and lighting and appliance branch-circuit panelboards.

1.3 REFERENCES

A. NEMA PB 1 - Panelboards; 2011.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

D. UL 67 - Panelboards; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard.
   1. Include name of manufacturer and model numbers.
   2. Include materials, switching and overcurrent protective devices, SPDs, accessories and components indicated.
   3. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Name of Manufacturer.
   2. Model number.
   3. Details of construction and installation.
   4. Project specific assembly drawings, including elevations, plans, sections, dimensions, weight, and conduit entry locations.
   5. Project specific electrical ratings:
      a. Voltage.
      b. Amperage.
      c. Short-circuit current rating of panelboards and overcurrent protective devices.
   6. Project specific enclosure types.
      a. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges and locks.
   7. Project specific color and finish.
   8. Project specific one line diagram.
   9. Project specific options and accessories.

C. Installation Instructions: For panelboards.

D. Operation and Maintenance Manuals: For panelboards.
   1. Equipment function, normal operating characteristics, and limiting conditions.
   2. Assembly, installation, alignment, adjustment, and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
   4. Maintenance instructions.
   5. Guide to “troubleshooting.”
   6. Parts list and predicted life of parts subject to wear.
   7. Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams.
   8. Test data and performance curves.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. All panelboards and accessories shall bear the UL label.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 240/120 V AC Maximum:
   1. Schneider Electric; Square D Products: NQ.
   2. Eaton Corporation: PRL1X.
   3. ABB, Inc.: ReliaGear Type RQ.
   4. Siemens USA: Type P1, P2 or P3 Series.

B. 480Y/277V AC Maximum:
   1. Schneider Electric; Square D Products: NF.
   2. Eaton Corporation: PRL2X.
   3. ABB, Inc.: ReliaGear Type RE/RS.
   4. Siemens USA: Type P1, P2 or P3 Series.

C. 480V AC Maximum:
   1. Schneider Electric; Square D Products: ILINE, QMB.
   2. Eaton Corporation: PRL3X, PRL4X.
   3. ABB, Inc.: ReliaGear neXT Series.
   4. Siemens USA.: Type P4 or P5 Series.

D. All panelboards shall be products of the same Manufacturer.

2.2 MATERIALS

A. General:
1. All panelboards shall have plated copper bus bars and full-sized neutral bar.
2. Bussing shall meet UL Standard 67 for maximum heat rise.
3. Bussing Type: Distributed phase.

B. Circuit Breaker Panelboards:
1. Automatic circuit breaker type with individual breaker unit for each circuit, interchangeable, and removable without disturbing adjacent units.
2. Complete front trim with door and flush lock, with 2 keys.
3. Cabinets and fronts shall meet UL Standards for gutter space and material gage.
4. All panelboards shall have common keying.
5. All panelboards shall have a circuit directory frame with plastic cover and card mounted inside cover.
6. Trim for panelboards shall have door-in-door construction with piano hinge. Outer door shall permit full access to the panelboard interior. Inner door shall permit access to breaker operating handles and labeling but current carrying terminals and bus shall remain concealed.
7. Flush mounted double tub panelboards in finished areas shall have a common front cover.
8. Panelboard shall have electrical rating as indicated on the Drawings.
9. Flush mounted panelboards shall have cover flange to overlap cabinet.
10. Finish panelboards in gray enamel over rust inhibitor primer.
11. Branch circuit breakers are to be bolt-on type.
12. Load centers not allowed unless noted otherwise.

C. Short-Circuit Rating: Provide a single integrated rating of each panelboard certifying capability of withstanding fault stresses equal to the lowest interrupting rating of any overcurrent protective device contained in the panelboard.

2.3 IDENTIFICATION

A. Panelboard Nameplate: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located at an accessible location on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated, typewritten circuit directory mounted inside panelboard door and placed in metal frame with transparent protective cover.
1. Circuit directory shall identify specific purpose and location of equipment served with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions under which panelboards and enclosures are to be installed and notify Engineer in writing of conditions detrimental to the operation or the proper and timely completion of the work.

3.2 INSTALLATION

A. Anchoring:

1. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secured.
2. Locate top of enclosures approximately 6'-0" above floor, at a masonry joint if applicable.
3. Mount free-standing distribution panelboards on 4-inch high concrete pads with 1-inch chamfered edges.
4. Where panelboards are flush mounted, stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab, not on grade, into accessible ceiling space below.

B. Circuit Directories:
1. Upon completion of work, install project specific, computer generated, typewritten circuit directories in all lighting and appliance branch-circuit panelboards.

C. Panelboard Identification Nameplates: Label each panelboard with a nameplate complying with the requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”

D. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”

E. Install warning signs complying with requirements in Division 26 Section “Identification for Electrical Systems” identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:
1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all wiring devices and the major items listed below:
   1. Switches
   2. Receptacles.
      a. Duplex.
      b. Ground Fault Circuit Interrupter Duplex.
   3. Wall plates and covers.

B. All devices shall be rated for 20A unless noted otherwise herein or on the Drawings.

C. Device models and colors shall be as indicated on the Drawings.

1.3 REFERENCE STANDARDS

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
   2. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   1. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: For wiring devices.
   1. Name of Manufacturer.
   2. Model number.
   3. Details of construction and installation
   4. Electrical specifications and ratings.
   5. Dimensional data.
   6. Color and finish.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70 (NEC).

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. General:
1. Provide factory-fabricated wiring devices in type, color, and electrical rating as indicated in the device schedule on the Drawings. .
2. Receptacles: Self-grounding, complying with NEMA WD 1 and listed as complying with UL 498.
   a. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.
   b. NEMA configurations specified are according to NEMA WD 6.
3. Where type and grade are not indicated, proper selection shall be determined by installer to fulfill the wiring requirements and to comply with NFPA 70 (NEC) and NEMA standards for wiring devices.

B. Manufacturers: Provide equal products by one of the following Manufacturers for switches and receptacles specified:
1. Eaton (Arrow Hart).
2. Leviton Manufacturing Co., Inc.
3. Hubbell Incorporated: Wiring Device-Kellems.
4. Pass & Seymour/Legrand (Pass & Seymour).

C. Switches:
1. Switch Rating: 20 amp, 1201277V, specification grade, quiet operating.
2. Switch Provisions: Back and side wiring.

D. Duplex Receptacles, Extra Heavy Duty:
1. Ratings: 20 amp, 125V, industrial, heavy duty, tamper-resistant, specification grade.
2. Provisions: Back and side wiring, grounding screw.
3. One-Piece Brass Ground Strap: 260 brass, 0.05-inch thick.

E. Ground Fault Circuit Interrupter Duplex Receptacles:
1. Ratings: 20 amp, 125V, self-test, extra heavy duty, industrial, tamper-resistant, specification grade.
2. Provisions: Feed through protection.
3. Nickel plated brass mounting strap.

F. Wall Plates:
1. Number: Provide a single (switch or duplex outlet) wall plate for wiring devices grouped at each location.

2. Attachment: Provide metal screws for securing plates to devices, screw heads colored to match finish of plate.
3. Construction:
   a. Stainless Steel: 0.04-inch thick, Type 302 satin finished stainless steel, accurately die cut, protected with release paper.
   b. Plastic: High abuse nylon or polycarbonate , color to match device.
   c. Cast Metal: Die cast profile, ribbed for strength, flash removed, painted with gray enamel, furnished complete with 4 mounting screws with gaskets.
   d. Steel: Hot dip galvanized, 1.25 ounce per square foot minimum.
4. Plate Application:
   a. Plate/cover application shall me the NEMA requirements of the installed area and maintain the NEMA rating of the installed device and backbox (i.e., wet locations shall utilize NEMA 3R, 4, or 4X, corrosive locations shall utilize 4X, etc.).
   b. When surface mounted device boxes are utilized, the plate shall match the box (i.e., a 4 square box shall require a raised device cover, an FS or FD box shall require an FS or FD device cover, and a PVC coated box shall require a PVC coated cover, etc.)
   c. Flush Mounting Devices: Beveled type with smooth edge:
      1) Finished Areas: Stainless steel and plastic.
      2) Unfinished Areas: Stainless Steel, plastic, and galvanized steel .
   d. Surface Mounted Devices In Unfinished Process Spaces: plastic .
   e. Weatherproof Outlet Covers and Face-Plates:
      1) Cast aluminum, NEMA 3R, Extra Duty, weatherproof while-in-use outlet cover with faceplate, faceplate gasket and corrosion proof fasteners.
      2) Manufacturers:
         (a) Hubbell.
         (b) Leviton.
         (c) ABB; Red Dot.
         (d) ABB; Carlon.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install wiring devices in accordance with:
      a. The Drawings.
      b. Manufacturer's written instructions.
      c. Applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation".
      d. Recognized industry practices to ensure that products serve intended function.
   2. Delay installation of devices until wiring is completed.
   3. Install receptacles and switches only in electrical boxes which are clean and free from excess building materials and debris.

B. Switches:
   1. Install as indicated on the Drawings to control lights as indicated.
   2. Where more than 1 wall switch is installed in same location, set under 1 cover plate.

C. Receptacles:
   1. Locate approximately as indicated on the Drawings, long dimension vertical, with grounding pole at top.
   2. Centerline generally at 16-inches above finished floor to bottom of outlet box, on a tile or block joint unless otherwise indicated on the Drawings.
   3. Refer to architectural Drawings for specific location requirements for architectural details when located above counters (long dimension horizontal), and for centering to meet architectural conditions.
   4. Refer to mechanical Drawings for coordination with mechanical equipment, radiation, fin tube, grilles, and diffusers.

5. Provide bonding jumper from outlet to box.
6. In areas designated as corrosive, install corrosion resistant receptacles.

D. Wall Plates:
1. Install coverplates on all wiring devices
2. Plate shall cover entire wall opening.

3.2 FIELD QUALITY CONTROL

A. Testing: Test wiring devices to ensure electrical continuity of grounding connections, and test after energizing circuitry, to demonstrate compliance with requirements.

3.3 PROTECTION OF WALL PLATES AND RECEPTACLES

A. Upon installation of wall plates and receptacles, advise Subcontractors regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

END OF SECTION

SECTION 26 28 00 - LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all low voltage circuit protective devices:
   1. The types of low voltage circuit protective devices required for the Project and specified in this Section include the following:
      a. Fuses.
      b. Circuit breakers.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
   2. NFPA 70 - NATIONAL ELECTRICAL CODE; ALL.
   3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Manufacturer’s literature for each type of low voltage circuit protective device furnished to include:
   1. Name of Manufacturer.
   2. Model.
   3. Time-current curves.
   4. Interrupt ratings.
   5. NEC class.
   6. Details of construction and installation.
   7. Options and accessories.

B. Installation Instructions: For low voltage circuit protective devices.

C. Operation and Maintenance Manuals: For low voltage circuit protective devices.
   1. Equipment function, normal operating characteristics, and limiting conditions.
   2. Assembly, installation, alignment, adjustment, and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
   4. Maintenance instructions.
   5. Guide to “troubleshooting.”
   6. Parts list and predicted life of parts subject to wear.
   7. Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams.
   8. Test data and performance curves.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Provide fuses and circuit breakers which have been tested, listed, and labeled by Underwriters' Laboratory.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 FUSES

A. General: Provide fuses manufactured by Bussmann, Inc. as required for all motor starters, fused disconnect switches, and other equipment requiring fuse protection as indicated on the Drawings, or in absence thereof, as selected by the installer to meet the specific electrical requirements of the equipment being served. Select only from the following:
   1. Dual element plug fuses, 0-30 ampere, 150 volt, 10,000 ampere interrupting rating: Buss "Fusetron".
   2. Dual element fuse, 0-600 ampere, 250 or 600 volt, 200,000 ampere interrupting rating, Type R-K5: Buss "Fusetron".
   3. 601 amperes and above, 250 or 600 volt, 200,000 ampere interrupting rating: Buss "Hi-Cap".

B. All fuses shall be by one Manufacturer.

2.2 CIRCUIT BREAKERS

A. General:
   1. Provide required circuit breakers for installation in panelboards, switchboards, individual enclosures, or motor control centers. Circuit breaker Manufacturer shall be that of the equipment in which it is installed or shall be supplied by that equipment Manufacturer.
   2. Provide electronic trip circuit breakers where indicated on the Drawings.
   3. All breakers shall be rated for the applied voltage and have a minimum 10,000-amp interrupt rating.

B. Manufacturer:
   1. When individually mounted, provide circuit breakers as manufactured by:
      a. Schneider Electric; Square D.
      b. General Electric; ABB, Inc.
      c. Eaton Corporation.
      d. Siemens, USA.

2. When mounted in a manufacturer provided assembly, circuit breaker manufacturer shall match assembly manufacturer. See other Division 26 Sections.

C. Mechanism: Molded case circuit breakers shall have over center toggle-type mechanisms, providing quick-make, quick-break action. Breakers shall be calibrated for operation in an ambient temperature of 40 degrees Celsius. Each circuit breaker shall have trip indication by handle position and shall be trip-free. 2 and 3 pole breakers shall be common trip.

D. Thermal Magnetic Trip:
1. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
2. Circuit breakers with frame sizes greater than 100 amperes shall have variable magnetic trip elements which are set by a single adjustment (to ensure uniform tripping characteristics in each pole).
3. Single pole 15 and 20 ampere breakers shall be SWD rated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in all combination motor starters, fused disconnects, and equipment as required.

B. Install circuit breakers in all panelboards, switchboards, and motor control centers as required.

3.2 FIELD SETTINGS

A. Perform field adjustments of overcurrent protective devices (circuit breakers) as required to place the equipment in final operating condition. Settings shall be in accordance with the recommendations of the reviewed coordination study.

END OF SECTION

SECTION 26 28 20 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all switching devices or means of disconnecting motors and other electrically powered equipment.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
   2. NFPA 70 - NATIONAL ELECTRICAL CODE; ALL.
   3. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Shop Drawings: For disconnect switches.
   1. Name of Manufacturer.
   2. Model number.
   3. Details of construction and installation.
   4. Assembly drawings, including elevations, plans, sections, dimensions, weight, and conduit entry locations.
   5. Electrical Ratings:
      a. Voltage.
      b. Amperage.
      c. Interrupt rating.
      d. Enclosure type.
   6. Color and finish.
   7. Options and accessories.

B. Installation Instructions: For disconnect switches.

C. Operation and Maintenance Manuals: For disconnect switches.
   1. Equipment function, normal operating characteristics, and limiting conditions.
   2. Assembly, installation, alignment, adjustment, and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
   4. Maintenance instructions.
   5. Guide to “troubleshooting.”
   6. Parts list and predicted life of parts subject to wear.
   7. Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams.
   8. Test data and performance curves.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Regulatory Agencies Requirements:
   1. Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical disconnect switches.
   2. Provide disconnect switches which have been listed and labeled by Underwriters' Laboratories.
   3. Comply with OSHA lockout/tagout requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers, or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 FABRICATED SWITCHES

A. Manufacturers: Provide products produced by one of the following Manufacturers (for each type of switch):
   1. Schneider Electric; Square D Products.
   2. General Electric; ABB, Inc.
   3. Siemens, USA.
   4. Eaton Corporation.

B. General:
   1. Provide heavy duty disconnect switches for all motors and equipment as indicated on the Drawings.
   2. Provide disconnect switches for all motors not in sight of supplying distribution panel whether indicated on the Drawings or not, as required by NEC.
   3. All disconnects shall be UL 98 listed unless noted otherwise on the Drawings or approved by the Engineer.

C. Switch Enclosures: Provide disconnect switches with NEMA enclosures 1, 3R, 4X, 7, or 12 as indicated on the Drawings, or in absence thereof, as determined by installer to fulfill the requirements of the environment.

D. Heavy Duty Safety Switches:
   1. Provide heavy duty type, sheet steel enclosed safety switches, of the type and size and electrical characteristics indicated, surface mounted, fusible or nonfusible, rated at 250 or 600 volts, 60 hertz, 3 blades, incorporating quick-make, quick-break type switches, constructed so switch blades are visible in "off" position with door open; equipped with operating handle which is an integral part of the enclosure base and whose position is easily recognizable and is padlockable in the "off"

position; with current carrying parts constructed of high-conductivity copper, and silver-tungsten type switch contact; with positive pressure type reinforced fuse clips.
2. Fuse clips shall accept only Class R type fuses.
3. All disconnect switches shall be horsepower rated.

E. Switch Interlock:
1. Provide switches with dual cover interlock to prevent opening door with switch in "on" position or closing switch with door open.
2. Interlocks shall be defeatable with the use of a screwdriver to intentionally gain access to an energized switch in the "on" position.

PART 3 - EXECUTION

3.1 INSPECTION

A. General:
1. Examine the areas and conditions under which disconnect switches are to be installed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the work.
2. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 INSTALLATION

A. General:
1. Install disconnect switches where indicated, in accordance with Manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended function.
2. Provide fused disconnect switches serving rooftop units and all other heating, air conditioning, and refrigeration equipment comprising of multimotor or combination loads.

B. Coordination: Coordinate disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Location:
1. Install disconnect switches used with motorized equipment within sight of the controller position unless otherwise indicated.
2. Mount on wall whenever possible, otherwise provide supporting device adjacent to equipment being served.

D. Fuses: Provide fuses for disconnect switches in accordance with Division 26 Section “Low Voltage Circuit Protective Devi ces.”

END OF SECTION

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all enclosed controllers and contactors.

B. The types of enclosed controllers and contactors required for the Project include the following:
   1. Manual motor starters.
   2. Magnetic motor starters.
      a. Combination magnetic motor starter/motor circuit protector disconnect switches.
   3. Contactors

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:

B. NEMA AB 3 - Molded-Case Circuit Breakers and Their Application; 2013.

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

D. NFPA 70 - NATIONAL ELECTRICAL CODE; ALL.

E. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

F. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

G. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

H. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2); Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed controller and contactor. Include shipping and operating weights, features, performance, electrical ratings, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each enclosed controller and contactor, manufacturer's approval drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Name of Manufacturer.
2. Model number.
3. Details of construction and installation.
4. Vertical and horizontal bus ratings.
5. Color and finish.
6. Options and accessories.
7. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Each installed unit's type and details.
   b. Factory-installed devices.
   c. Enclosure types and details.
   d. Nameplate legends.
   e. Short-circuit current (withstand) rating.
   f. Features, characteristics, ratings, and factory settings of each installed device.
   g. Specified optional features and accessories.
8. Project Specific Schematic and Connection Wiring Diagrams:
   a. Identify power, signal, and control wiring for each installation configuration.
   b. Clearly identify all field wiring requirements.
   c. Typical diagrams are acceptable for multiple motors or loads controlled in the same manner.

C. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

D. Installation Instructions: For enclosed controllers and contactors. Include a copy of the Manufacturer's Field Service Division's commissioning, acceptance testing, and start up procedures.

E. Operation and Maintenance Manuals: For enclosed controllers and contactors:
1. Equipment function, normal operating characteristics, and limiting conditions.
2. Assembly, installation, alignment, adjustment, and checking instructions.
3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
4. Maintenance instructions.
5. Guide to "troubleshooting".
6. Parts lists and predicted life of parts subject to wear.
7. Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams. Wiring diagrams shall reflect final, as-installed conditions and include wire numbers.
8. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer, Contractor, or both.
9. Test data and performance curves.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed submittals.

B. All equipment shall be tested in accordance with NEMA ICS-2, bear the UL Label, and be listed for the application specified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.7 COORDINATION

A. Coordinate features of enclosed controllers, contactors, and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each enclosed controller and contactor with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor or load.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Power Fuses: Equal to 10% of quantity installed for each size and type, but no fewer than 3 of each size and type. Provide 1 fuse puller.
   2. Control Circuit Fuses: Equal to 10% of quantity installed for each size and type, but no fewer than 2 of each size and type. Provide 1 fuse puller.
   3. Indicating Lights: 2 lamps and lenses of each type and color installed.
   4. Auxiliary Contacts: 1 spare for each size and type installed.
   5. Power Contacts: 3 spares for each size and type of installed.
   6. Coils: 1 for each size and type installed.
   7. Overload Relays: One for each size installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide products manufactured by one of the following:
   1. Eaton Corporation.
   2. General Electric; ABB, Inc.
   3. Rockwell Automation; Allen-Bradley.
   4. Schneider Electric; Square D Products.
   5. Siemens USA.

B. All products to be of the same Manufacturer.

2.2 MATERIALS AND EQUIPMENT

A. Manual Motor Starters for Fractional HP Motors:
   1. Operating mechanism shall be of the quick-make, quick-break toggle switch type and shall be mechanically trip-free requiring a reset operation before the starter can be reset. Contacts shall be silver alloy. Non-current carrying parts shall be mounted on molded porcelain, bakelite, or composition base.
   2. Overload protection shall be provided with 1 thermal overload heater block for each pole. All overload relays shall be of the melting alloy type.
   3. All FHP manual starters shall be equipped with thermal overload relay and handle guard/lock-off mechanism.
   4. Manual starters shall include an on-off indicating light. Light to be red unless indicated otherwise.

B. Enclosed Controllers:
   1. Motor Starters: Combination type (disconnect and controller) rated in accordance with NEMA size designations. Fractional sizes and ratings in accordance with IEC recommendations are not acceptable. Comply with NEMA ICS 2, general purpose, Class A.
   2. Circuit Breakers (Motor Circuit Protector) Disconnect: UL 489, NEMA AB 1, and NEMA AB 3, with interrupting rating to comply with available fault current, instantaneous (magnetic trip) only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes. Ampere rating to be selected per horsepower indicated on the Drawings. Lockable Handle: Accepts 3 padlocks and interlocks with cover in closed position and includes a defeatable interlock to prevent opening unless the disconnect is OFF. Auxiliary contacts “a” and “b” arranged to activate with MCP handle.
   3. Controllers:
      a. Full-voltage, non-reversing, NEMA Size 1 (minimum), electrically held, field replaceable coil and contacts, auxiliary contacts field installable and removable. Terminal temperature rise is not to exceed 122 degrees Fahrenheit in accordance with NEMA standards.
   4. Overload Relays:
      a. Solid State Type:
         1) Self-powered, with current trip range adjustability. Switch or dial selectable for motor running overload protection.
         2) Sensors in each phase.
         3) Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
         4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
         5) Provide cover mounted “reset” pushbutton.
   5. Contactor Coils: Pressure-encapsulated type.
   6. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide, assembled to allow inspection and replacement without disturbing line or load wiring.
   7. Terminal Blocks: Pull apart type for power and control to allow unit withdrawal without disconnecting wiring. Use screw type terminals suitable for ring and tongue lugs for control wiring and box lug type for power wiring.
   8. Control Power: 120 VAC; obtained from integral CPT, with primary and secondary fuses; with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices. Spare capacity of _____ kVA.
   9. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller.

C. Enclosures:
   1. Provide NEMA enclosures 1, 3R, 4X, 7 or 12 as indicated on the Drawings or schedules, or in absence thereof, as determined by installer to fulfill the requirements of the environment.
   2. Constructed to fully compartmentalize the starter and arranged to permit access to starter, contactor, control power transformer, fuses, and other components without requiring disassembly.

D. Contactors:
   1. Provide contactors that have voltage and current rating as indicated on the Drawings.
   2. Suitable for continuous duty with all types of loads.
   3. Totally enclosed silver alloy double break power contacts capable of making and breaking any load within the rating of the contactor without the assistance of auxiliary arcing contacts. Contacts shall be removable without disturbing line or load wiring.
   4. Industrial duty and rated 600 volts even though they may be used for commercial duty or at lower voltage or both.
   5. Electrically Held: Contactor coils shall be continuously rated and encapsulated.
   6. Contactors: Have on-off-auto switch in cover of enclosure.
   7. Contactors shall include an LED push to test type on-off indicating light. Indicating light shall be red in color unless noted otherwise.

E. Auxiliary Devices:

1. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; UL listed; factory installed in enclosure cover unless otherwise indicated.
   a. Push Buttons, Indicating Lights, and Selector Switches: Full size, heavy-duty, oil-tight type, industrial grade.
      1) Push Buttons: Maintained or momentary contacts as indicated.
      2) Indicating Lights: LED type; color as indicated; with push to test feature where indicated.
      3) Selector Switches: Maintained contacts with number of positions as indicated.
   b. Elapsed-Time Meters: Six digit, non-resettable, heavy-duty with readout in hours and tenths.
2. Control Relays: Heavy duty, 600 volt, machine tool type, 10 amp (minimum) contact rating. Auxiliary and adjustable solid-state time-delay relays. Provide retaining clips with plug-in type relays.
3. Refer to wiring diagrams on the Drawings for additional requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions under which enclosed controllers and contactors are to be installed and notify Engineer in writing of conditions detrimental to the operation or the proper and timely completion of the Work.

3.2 INSTALLATION

A. General:
   1. Install enclosed controllers and contactors at locations indicated on the Drawings.
   2. In accordance with Manufacturer’s instructions.
   3. Comply with NECA 1.
   4. Overload elements and settings shall be selected based on motor nameplate ratings.
   5. Bundle, train, and support wiring in enclosures.

B. Wall-Mounted Enclosures: Install on walls with tops at uniform height, and with disconnect operating handles not higher than 72 inches above finished floor, unless otherwise indicated, and by mounting on channels bolted to wall. For enclosed controllers not at walls, provide free-standing racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

C. Identification: Label each enclosed controller and contactor with a nameplate complying with the requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”

3.3 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Verify that voltages at controller locations are within 10% of motor nameplate rated voltages.
   2. Test each motor for proper phase rotation.
   3. Test insulation resistance for each enclosed controller, contactor, component, connecting supply, feeder, and control circuit.
   4. Test continuity of each circuit.

B. Engage a factory-authorized service representative to perform the following inspections, checks, and startup supervision:
   1. Perform manufacturer certified start up and commissioning for all devices and equipment related to enclosed controllers and contactors. Include all items listed in the Manufacturer’s Field Service Division’s commissioning, acceptance testing, and start up procedures.
   2. Inspect field-assembled components, equipment installation, and electrical connections for compliance with the manufacturer's installation recommendations and requirements.

3. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges. Adjust overload elements based on motor nameplate rating. If capacitors are installed between the relay and motor, adjust overload based on the measured motor current.
4. Adjust trip settings of motor circuit protectors and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times motor full-load amperes (or 11 times for NEMA Premium Efficient motors). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.
5. Test and adjust controls and safety devices.
6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
7. Witness initial energization and perform or supervise startup services.
8. Complete installation and startup checks according to manufacturer's written instructions.
9. Prepare and submit written report to record the following:
   a. Inspections and checks carried out on Site.
   b. Test procedures used.
   c. Test results that comply with requirements.
   d. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
   e. Document settings for all protective and safety devices.
10. Minimum On Site Time: 1 day(s).
11. Coordinate scheduling and duration of Manufacturer’s inspections and startup activities with construction schedule to ensure items are completed in a timely manner and reports are submitted prior to turning equipment over to the Owner.
12. Promptly make all changes and additions required by Manufacturer's representative.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain components of enclosed controllers and contactors. Review operation and maintenance manual with Owner's personnel. Three 2-hour review sessions shall be scheduled to coordinate with schedules of Owner's personnel (i.e., day/morning and afternoon/evening shifts). Each review session shall accommodate up to 4 individuals. Submit detailed outline for each review session prior to scheduling. Owner reserves the right to videotape review sessions. Videotaping will be done by Owner.

END OF SECTION

SECTION 26 29 23 - VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

B. Reference the Drawings for wiring diagrams.

C. Reference Division 40 Section "Instrumentation and Control for Process Systems" for additional VFD operational requirements.

1.2 SUMMARY

A. This Section includes the furnishing and installation of variable frequency drives (VFDs) including:
   1. Individually mounted VFDs that are a complete packed systems, engineered to meet the requirements indicated herein and on the Drawings.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. IEEE 519 - IEEE Standard for Harmonic Control in Electric Power Systems; 2022.
   2. IEEE C62.41.1 - IEEE Standard Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits; 2002 (Reaffirmed 2008).
   3. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
   4. IEEE C62.45 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits; 2002.
   5. NEMA AB 3 - Molded-Case Circuit Breakers and Their Application; 2013.
   6. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
   7. NEMA IS 10033 - Industrial Control and Systems: Adjustable-Speed Drives; 2026.
   8. NEMA IS 10034 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems; 2022 (Reapproved 2025).
   9. NFPA 70-2023 - National Electrical Code; 2023.
   10. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
   11. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
   12. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.
   13. UL 845 - Motor Control Centers; Current Edition, Including All Revisions.
   14. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Shop Drawings: For VFDs.
   1. Name of Manufacturer.
   2. Model number.
   3. Details of construction and installation.
   4. Assembly drawings, including elevations, plans, sections, dimensions, weight, and conduit entry locations.
   5. Project Specific Wiring Diagrams:

a. Diagrams shall clearly identify all field wiring requirements.
b. Typical diagrams are acceptable for multiple motors controlled in the same manner.

6. Electrical Ratings:
   a. Voltage.
   b. Horsepower.
   c. Interrupt rating.
   d. Enclosure type.
7. Color and finish.
8. Options and accessories.

B. Installation Instructions: For VFDs.

C. Manufacturer's startup reports.
   1. Reports to be submitted within 48 hours of completion of startup.

D. Warranty statement:
   1. Warranty statement shall be issued at substantial completion for the project and shall clearly state the start and end dates of the warranty.
   2. Length of warranty shall be as stated within this Section.

E. Operation and Maintenance Manuals: For VFDs.
   1. Equipment function, normal operating characteristics, and limiting conditions.
   2. Assembly, installation, alignment, adjustment, and checking instructions.
   3. Operating instructions for startup, routine and normal operating, regulation and control, shutdown, and emergency conditions.
   4. Maintenance instructions.
   5. Guide to "troubleshooting".
   6. Parts lists and predicted life of parts subject to wear.
   7. Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams. Wiring diagrams shall reflect final, as-installed conditions, and include wire numbers.
   8. Test data and performance curves.
   9. Manufacturer's startup reports.
   10. Test reports.
   11. Warranty statement including dates of coverage.
   12. Electronic copies of all equipment documentation (i.e., installation instructions, maintenance instruction, project specific wiring diagrams, project specific configuration parameters, etc.) shall be submitted on USB flash drive. Electronic files shall be Acrobat Reader (.PDF) files or AutoCAD (.DWG) files.
   13. Configuration Parameters: Provide list of all configurable parameters. Indicate which parameters were changed from default values.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. VFD Supplier: Provide factory authorized service center within 100 miles of the installation Site.

C. Manufacturer's Services:
   1. Provide Manufacturer's field startup service.

D. All VFD assemblies shall be listed and labeled by UL or ETL for compliance with UL 508.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivered materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.7 WARRANTY

A. Manufacturer shall provide a comprehensive, on-site product warranty, including parts, labor and travel expenses, for a period of not less than 3 years from date of installation.

PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES (VFDS)

A. Manufacturers: All VFDs shall be by the same manufacturer.
   1. ABB.
   2. Rockwell Automation; Allen Bradley.
   3. Schneider Electric; Square D Products.
   4. Eaton Corporation.

B. General:
   1. VFDs shall be capable of operating any NEMA Design B squirrel cage induction motor, regardless of manufacturer.
   2. VFDs shall be rated for variable (normal duty) or constant (heavy duty) torque as indicated herein or on the Drawings. When not indicated, provide VFDs rated for variable torque applications.
   3. VFDs shall utilize pulse width modulation (PWM) technology, converting input voltage and frequency to a variable voltage and frequency output via a 2-step operation. Insulated gate bipolar transistors (IGBTs) shall be used in the inverter section.
      a. The rectifier stage shall convert fixed voltage, fixed frequency, AC line power to a fixed DC voltage. The rectifier shall be insensitive to phase rotation of the AC line. The DC voltage shall be filtered.
      b. The inverter shall change the fixed DC voltage to a variable frequency AC output.
   4. VFD output, actuation, and braking shall be sequenced and coordinated to provide smooth starting and stopping.
   5. Each VFD shall be able to start into a spinning motor by being able to determine motor speed, in any direction, and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and accelerate the motor to the required speed. VFDs shall be capable of being run without a connected load.
   6. Separate supply side and load side lugs and terminal blocks shall be provided for power and control wiring connections.

C. Operating Conditions:
   1. Incoming Power: 480 VAC, 3-phase, ± 10%; 60 Hz, ± 5 Hz.
   2. Frequency Stability: ± 0.05% with voltage regulation of ± 1% of maximum rated output voltage.
   3. Speed Regulation: ± 0.5% of base speed.

4. Load inertia dependent carryover (ride-through) during utility loss. Each VFD shall have a minimum power loss ride-through of 5 cycles.
5. Insensitive to input phase rotation.
6. Humidity: 0 to 95%, non-condensing and non-corrosive.
7. Altitude: 0 to 3,300 feet above sea level.
8. Ambient Temperature: 0 to 104 degrees Fahrenheit.
9. Storage Temperature: -40 to 140 degrees Fahrenheit.
10. To ensure adequate heat dissipation, fan assisted cooling or circulation may be provided such that it does not degrade the enclosure rating. See additional requirements for fans herein.

D. VFD Ratings:
1. Full load output current rating shall be based on 104 degrees F ambient and 10 kHz switching frequency below 40 HP and 3.6 kHz, 40 HP and above. Upon sensing an over-temperature, VFD shall fold-back switching frequency to reduce operating temperature. VFD shall return to the rated switching frequency after the over-temperature condition has passed.
2. Each VFD shall have an efficiency that exceeds 95% for loads below 15 HP and exceeds 97% for loads 15 HP and above. Efficiency shall exceed 90% at 50% speed and load.
3. Each VFD shall maintain a line side displacement power factor at no less than 0.95, regardless of speed and load.
4. VFD shall have a 1-minute overload current rating at 120% for variable torque applications; 150% for constant torque applications.
5. Each drive shall be able to provide rated motor torque at 0.5 Hz.
6. Individual mounted VFD shall be housed in a enclosure rated for its installed environment.
   a. Review Area Classification Drawings, when provided, for room/space ratings.
   b. Review plan Drawings, one line diagrams, and wiring diagrams for minimum enclosure NEMA ratings.
   c. Where no enclosure rating is indicated, provide a minimum enclosure rating of NEMA 12.
7. Output frequency of each drive shall be adjustable from 0-400 Hz.
8. Each VFD shall include automatic slip compensation and DC injection braking
9. Each VFD shall be rated for 42K AIC (minimum).

E. Protection:
1. Each VFD shall include protection against short circuits between output phases, between output phases and ground, on the output, on the internal supplies, and on the logic and analog outputs.
2. Each VFD shall have an auto restart function which will provide up to 5 restart attempts on a fault condition other than a ground fault, short circuit, or internal fault. A programmable time delay before restart attempt from 1 to 600 seconds shall be included.
   a. Automatic restart shall be disabled by default.
3. Deceleration shall be programmable for normal and fault conditions.
4. Upon loss of analog input, the VFD shall indicate a fault and be capable of being programmed to operate at a user defined speed.
5. Solid state I^2t protection shall be included that is adjustable from 45 to 105% of the current output of the drive. The protection shall be UL listed and meet UL 508C as Class 10/20 overload protection.
6. Each VFD shall have a thermal switch with an adjustable prealarm that will provide a minimum of a 60 second delay before an over temperature fault.
7. Each VFD shall include a programmable fold-back function that will anticipate controller over temperature and/or overload conditions and fold back the output frequency to avoid fault conditions.
8. The internal power supply shall include protection from incorrect connection and shorting. Logic outputs shall be current limited and shall not be damaged from shorting or excess current draw.
9. Each VFD shall include the following protective features:
   a. Overcurrent.
   b. Overvoltage.
   c. Phase rotation insensitive.
   d. Input phase loss.
   e. Input overvoltage.
   f. Line surge.
   g. Output short circuit.
   h. Output ground fault.

i. Output phase loss.
j. Over-temperature.
k. DC overvoltage.
l. Drive overload.
m. Motor overload.
n. Motor underload.
o. Inverter fault.
p. Motor high winding temperature (temperature switch(es) wired to VFD as a discrete input).
q. Selectable automatic restart after power loss or on resettable trip.
r. Stall protection (0% to 200%, 2 to 120 seconds).
s. Microprocessor failure.

10. Each VFD shall provide ground fault protection during power-up, starting, and running.
11. Each VFD shall include internal diagnostics for valid operation of memory, option module, loss of analog input, communications loss, dynamic brake failure, power supply failure, and loss of control power. VFD run status and fault types shall be recorded in each drive's memory for the past 9 faults (minimum). On a fault, the VFD shall shut down without damage to itself or other non-faulted equipment.
12. Each drive shall provide Class 10/20 overload protection.
13. Each VFD shall be provided with a conformal coating applied to all sensitive electrical components.

F. Adjustments and Configurations:

1. Three types of acceleration and deceleration ramps shall be available to be programmed into the VFD: linear, S curve and U curve. Acceleration and deceleration ramp times shall be adjustable from 0.1 to 3,000 seconds.
   a. VFDs shall include two-part ramps for starting (acceleration) and stopping (deceleration). For starting, VFD shall be able to ramp quickly from 0 to an operator adjustable speed or percentage, then ramp from that speed to the desired operating speed in an operator adjustable time period. For stopping, VFD shall ramp from operating speed to an operator adjustable speed or percentage in an operator adjustable time period, then ramp quickly from that speed to 0.
2. Each VFD shall be able to be programmed for open loop sensorless vector or V/Hz frequency control mode.
3. The volts per frequency (V/Hz) ratios shall be user selectable to meet various torque applications. The V/Hz output shall not be affected or require readjustment when other drive adjustments (such as maximum speed) are changed.
4. For variable torque applications, the VFD shall include a no-load function that allows the voltage to the motor to be reduced. A constant V/Hz will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirements of the load.
5. Each VFD shall include slip compensation.
6. Three skip frequency ranges (for critical frequency avoidance) shall be provided with selectable 2 or 5 Hz bandwidths. The skip frequencies shall be able to be programmed independently, back to back or overlapping.

G. Operator Interface:

1. A door mounted operator interface (OI) panel shall be included with each VFD. The panel shall be an alphanumeric, LCD display panel with a terminal keypad and status indicators. From the panel, an operator shall be able to view and/or adjust all configuration, programming, diagnostic, and operating parameters and I/O assignments. Access to configuration parameters shall be protected to prevent unauthorized adjustments. Operator interface panel shall be accessible without having to open the enclosure.
2. Each VFD shall include indicator for VFD power ON and other conditions as specified herein.

H. Control:

1. Each VFD shall be capable of interfacing with external pilot device for starting/stopping, speed control, and operational status.
2. Control power shall be supplied from an internal power supply (120VAC or 24VDC). Power supply shall be sized to supply power to auxiliary devices as required. Interposing relays shall be provided

as required to be compatible with signal wiring. Coordinate signal voltages with existing field devices interfacing with VFD.

3. Each VFD shall include a minimum of 5 programmable digital inputs, 2 analog inputs (operator selectable for 0-20 mA, 4-20 mA, 20-4 mA, 0-5 V, 1-5 V, or 0-10 V), 3 programmable relay (Form C) outputs, and 2 analog outputs (operator selectable for 0-20 mA, 4-20 mA, 20-4 mA, 0-5 V, 1-5 V, or 0-10 V). The analog outputs shall be able to be programmed to be proportional to frequency, current, power, torque, or voltage. Additional I/O shall be provided as required to achieve functionality as indicated on drawings and described herein.
4. Refer to wiring diagrams for specific control device requirements. Equipment Suppliers are responsible for coordinating control devices required by respective equipment.
   a. The following door mounted devices shall be provided:
      1) Hand-Off-Auto, or Local-Off-Remote as indicated on the Drawings, maintained position, 22.5 mm selector switch, equal to Allen-Bradley 800MR. Auxiliary contact on the Hand-Off-Auto selector switch to provide indication that the switch is in the Auto position.
      2) Elapsed time indicator, synchronous motor type, 5/32-inch minimum display size.
      3) Push-to-Test, 22.5mm, LED type, red RUNNING indicating light, equal to Allen-Bradley 800MR.
      4) Push-to-Test, 22.5, LED type, amber VFD FAULT indicating light, equal to Allen-Bradley 800MR.
      5) Reset pushbutton, equal to Allen-Bradley 800MR.
      6) Door mounted devices shall be mounted between 40 inches and 60 inches above finished floor or grade.

I. Accessories:
1. Circuit breaker disconnect to disconnect all incoming AC power. Handle position shall indicate ON, OFF, and TRIPPED conditions. Disconnect shall be interlocked to prevent unauthorized opening/closing of the VFD door with the handle in the ON position. Interlock shall be defeatable. Disconnect shall be lockable.
2. Ethernet/IP Ethernet Communication Module. Coordinate communication module with SCADA system architecture and system component manufacturers.
3. Provide circulating or cooling fans of size and quantity as required. Fans shall be thermostatically or otherwise controlled and have a delayed off time feature (set to turn fan(s) off 20 minutes after VFD shuts down). Fans shall not run constantly.
4. Heavy duty, industrial control relays with tubular pin terminal, pure silver contacts, and IP20 sockets, quantity as required.
5. Contactors: Where required for VFD or bypass operation, provide NEMA rated, magnetically held, field replaceable coil and contacts, auxiliary contacts field installable and removable. Terminal temperature rise is not to exceed 122 degrees Fahrenheit in accordance with NEMA standards.

2.2 HARMONIC DISTORTION MITIGATION

A. VFDs shall limit harmonic distortion reflected onto the power distribution system to the voltage and current levels defined by IEEE 519.
1. Unless noted otherwise, a harmonic analysis is not required for verification that IEEE 519 requirements have been met.
2. VFDs shall utilize 6-pulse technology.
3. VFDs shall include an active front end harmonic filter.
4. Provide a 3% input line reactor (minimum) with each VFD.

2.3 SPARE PARTS

A. 1 set of fuses for each size and type provided.

B. 1 set of MOVs.

C. 1 set of fan(s).

D. 2 sets of control power fuses for each size and type provided.

E. 2 pilot lights of each type provided.

F. 1 keypad for each type provided.

G. 2 sets of filters (for fans/ventilation).

2.4 SHAFT GROUNDING RINGS (SGRS) AND HIGH FREQUENCY BONDING

A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR's Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, or approved equal.

B. Motors up to 100 HP shall be provided with one shaft grounding ring installed on either the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated, and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the shaft grounding ring manufacturer's recommendations.

C. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high-frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection. Provide AEGIS HF Ground Straps, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all required motor overloads sized in accordance with motor nameplate FLA.

B. Locate VFD as indicated on the Drawings.

C. Ensure unrestricted access to ventilation for VFD.

D. Install all free-standing, floor-mounted VFDs on a concrete housekeeping pad.

E. Separate line, load, and control conductors per the Manufacturer's instructions (in separate conduits).

F. Reference Manufacturer's literature for any special grounding requirements.

3.2 SHAFT GROUNDING RINGS

A. Shaft grounding rings (SGR) shall be factory installed inside the motors by the manufacturer wherever possible. SGRs may be field installed by installing contractor subject to Engineer's approval. Provide AEGIS SGR Colloidal Silver Shaft Coating, or approved equal, on shafts prior to rings installation, in accordance with SGR manufacturer's recommendations, after first cleaning shafts.

B. Install and test SGRs in accordance with manufacturer's recommendations. Install the SGR so that the aluminum frame maintains an even clearance around the shaft. Conductive microfibers shall be in full circumferential contact with conductive metal surface of the shaft. Do not use thread lock to secure the mounting screws as it may compromise the conductive path to ground. If thread lock is required, use a small amount of EP2400 AEGIS Conductive Epoxy, or approved equal, to secure the screws in place.

C. Shafts shall be clean and free of any coatings, paint, or other nonconductive material (clean to bare metal). Depending upon the condition of the shaft, it may require using emery cloth or Scotch-Brite. If the shaft is visibly clean, a non-petroleum-based solvent may be used to remove any residue. Check the conductivity of the shaft using an ohm meter. Ohms test: Place the positive and negative meter leads on the shaft at a place where the microfibers will contact the shaft. Each motor will have a different reading but in general one should have a maximum reading of less than 2 ohms. If the reading is higher, clean the shaft again and retest.

D. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter. Place one probe on metal frame of SGR and one probe on motor frame. Motor must be grounded to common earth ground with variable frequency drive according to applicable standards. Verify that SGR installations and test readings comply with SGR manufacturer's requirements.

3.3 HIGH-FREQUENCY BONDING

A. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high-frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection. Provide AEGIS HF Ground Straps, or equal. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Arrange and pay for Manufacturer's engineer to provide the services indicated below for a minimum onsite time of 2 day(s), or as needed to completely startup and commission all VFDs in accordance with the Manufacturer's instructions. Provide individual startup and testing reports for each VFD. Schedule the following as soon as practicable after installation and at times approved by Engineer and Owner.
   1. Manufacturer's Engineer:
      a. Check work.
      b. Configure, program, and commission VFDs. Coordinate with startup schedule of related equipment.
      c. Assist in startup and modify configuration parameters as required to coordinate equipment operation with SCADA controls.
      d. Demonstrate operation and maintenance to Owner's personnel.
      e. Review operation and maintenance manual with Owner's personnel. Two 2-hour review sessions shall be scheduled to coordinate with schedules of Owner's personnel (i.e., day/morning and afternoon/evening shifts). Each review session shall accommodate up to 8 individuals. Submit detailed outline for each review session prior to scheduling. Owner reserves the right to record review sessions. Recording will be done by Owner.
      f. Adjust device configuration parameters as required. All drive parameters shall be documented and included in the operations and maintenance manuals and startup reports.

B. Promptly make all changes and additions required by Manufacturer's engineer.

END OF SECTION

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Engine driven generator.
   2. Cooling system.
   3. Exhaust system.
   4. Fuel system.
   5. Battery and battery charging system.
   6. Control and instrument panel.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following as applicable:
   1. IEEE 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications; 1995.
   2. IEEE C62.41.1 - IEEE Standard Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits; 2002 (Reaffirmed 2008).
   3. NEMA ICS 1 - Industrial Control and Systems General Requirements; 2022.
   4. NEMA MG 00001 - Motors and Generators; 2024.
   5. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2024, with Amendment.
   6. NFPA 54 - National Fuel Gas Code; 2024.
   7. NFPA 70 - NATIONAL ELECTRICAL CODE; ALL.
   8. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.
   9. UL 499 - Electric Heating Appliances; Current Edition, Including All Revisions.
   10. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.
   11. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
   12. UL 2085 - Protected Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
   13. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.4 SYSTEM DESCRIPTION

A. Standby Power System Operation:
   1. Initiate engine generator starting upon loss of normal electrical power.
   2. Transfer load to generator:
      a. Automatically.
      b. When generator reaches rated voltage and frequency.
      c. Within 60 seconds of loss of normal electric power.
   3. Retransfer Load to Normal Electric Power: Automatically.
   4. Initiate engine generator shutdown.

B. All change-in-system status functions are subject to adjustable time delays as specified in Division 26 Section “Transfer Switches.”

C. The maximum instantaneous voltage dip of the generator shall not exceed the specified percent as defined by NEMA MG1-16.48.

D. All automatic load transfers shall occur after a time delay with transfer switch in a "neutral-off" position.

1.5 SUBMITTALS

A. Shop Drawings: For engine generator system:
   1. Name of Manufacturer.
   2. Model number.
   3. Details of construction and installation.
   4. Assembly drawings, including elevations, plans, sections, dimensions, weight, and conduit entry locations.
      a. Vibration isolation details. Detail fabrication, including anchorages and attachments to structure and supported equipment.
   5. Project Specific Wiring Diagrams:
      a. Diagrams shall clearly identify all field wiring requirements between generator set(s), transfer switch(es), and other remote devices.
      b. Connection points shall be identified by terminal number.
   6. Engine and generator data.
      a. Output voltage.
      b. Rated capacity.
      c. Fuel type.
      d. Thermal damage curve for generator.
      e. Generator reactance values.
   7. Time-current characteristic curves for generator protective device(s).
   8. Cooling, exhaust, and fuel system data.
   9. Heat dissipation.
   10. Ventilation requirements.
   11. Control panel and instrument details.
   12. Color and finish.
   13. Options and accessories.

B. Calculations:
   1. Battery sizing.

C. Operation and Maintenance Manuals:
   1. Equipment function, normal operating characteristics, and limiting conditions.
   2. Assembly, installation, alignment, adjustment, and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   4. Maintenance instructions.
   5. Guide to "troubleshooting".
   6. Parts list and predicted life of parts subject to wear. List of tools and replacement items recommended to be stored at Site for ready access. Include part and drawing numbers, current unit prices, and source of supply.
   7. Project specific outline and cross-sections, assembly drawings, engineering data, and wiring diagrams. Wiring diagrams shall reflect final, as-installed conditions, and include wire numbers.
   8. Test and performance data as applicable.
   9. Warranty information clearly indicating starting and ending dates.

D. Manufacturers Installation Instructions: include recommended commissioning, acceptance testing, and startup procedures, instructions, and guidelines.

E. Test Reports:
   1. Certified factory performance testing results.
   2. Load bank testing results.
   3. Performance and functional testing results.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Manufacturer's Services:
   1. Provide Manufacturer's field service for start-up and testing.
   2. Provide Manufacturer's authorized service organization within 100 miles of Site.

C. Testing:
   1. Provide factory performance testing at rated load and power factor for assembled engine generator prior to shipment. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady state governing, single step load pickup, and function of safety shutdowns.
   2. Provide load bank and field performance testing as specified herein prior to acceptance.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer’s directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.8 WARRANTY

A. Provide a 5 year written warranty from startup date, executed by Manufacturer, agreeing to repair or replace engine generator and auxiliary components that fail within specified warranty period. Warranty shall be comprehensive covering parts and labor with no deductibles allowed for travel time, service hours, repair parts cost, etc.

1.9 SPARE PARTS

A. Furnish the following spare parts:
   1. Fuses: Three of each type and rating. Provide 1 fuse puller.
   2. Pilot light lamps: Five of each type provided.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters for each engine generator provided.
   4. Belts: One complete set for each generator___.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Engine Generators:
1. Cummins.
2. MTU.
3. Generac.
4. Kohler

B. Exhaust Silencers:
1. Silex Innovations.
2. EM Products.
3. GT Exhaust Systems.
4. Nelson.
5. Or equal.

2.2 EQUIPMENT RATING

A. Engine Generator:
1. Output Voltage: 208Y/120V-3φ-4W .
2. Rated Capacity: Minimum size as indicated on the Drawings at 0.8 P.F., 60 Hz, standby duty. Engine generator system Supplier is responsible for calculating size of engine generator system, including alternator, required to start and operate the following loads when operating to deliver standby power:
3. Engine generator set shall be capable of accepting a single step load of 100% nameplate kW and power factor, less applicable derating factors, with engine generator set at operating temperature.
4. Fuel: Natural gas.
5. Altitude: 663 feet above sea level.
6. Ambient Temperature: 100 degrees F.
7. Engine generator Supplier shall size engine cooling system to provide cooling for engine generator in accordance with Manufacturer's recommendations based on the following design criteria:
   a. Ambient air temperature: 110 degrees F.
   b. Altitude: 663 feet above sea level.
   c. Maximum coolant pressure drop through core: 2 psi.
   d. Maximum noise level at 24 feet from radiator: 65 dBA.
   e. Coolant temperature at radiator inlet (top tank): 210 degrees Fahrenheit.
   f. Air temperature rise: 11 degrees Fahrenheit.
   g. Coolant:
      1) 50% ethylene-glycol-based antifreeze and 50% water, with anticorrosive additives as recommended by engine manufacturer.
      2) Freezing protection: -104 degrees Fahrenheit.
      3) Boiling protection: 264.2 degrees Fahrenheit.
      4) Coolant shall require no supplemental coolant additives or cleaning agents.

2.3 COMPONENTS

A. Engine:
1. Liquid cooled.
2. Spark ignited.
3. 4-cycle, 1800 RPM maximum.
4. Governor: Electronic isochronous control with ±0.25% steady state regulation.
5. Lubrication system:
   a. Positive displacement, engine-driven, full pressure, lubrication oil pump.
   b. Full flow strainer.
   c. Full flow filter(s) with replaceable canister elements and dipstick oil level indicator.

d. Oil level indicating pressure gauges on the upstream and downstream sides of the strainer and filter.
e. Thermostatically-controlled valve to control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and designed to be fail-safe.
f. Low oil pressure safety shutoff.
g. Pressure relief and automatic bypass valves.

6. Engine-mounted battery charging alternator, 40-ampere minimum, with solid state voltage regulator.
7. Dry-type heavy duty replaceable air cleaner/filter with restriction indicator.
8. Crankcase drain arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances. Provide oil drain extension kit as required.

B. Generator:

1. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds and then clear the fault automatically, without damage to generator system components. Performance shall be unaffected by voltage distortion caused by nonlinear loads.
2. Synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed maintenance-free bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc.
3. Broad range reconnectable. Unit configured for 1 voltage only is not acceptable.
4. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation systems. Actual temperature rise measured by resistance method at full load shall not exceed 125 degrees C.
5. Subtransient reactance of the alternator shall not exceed 15%, based on standby rating of generator set.
6. Voltage Regulator:
   a. Solid state.
   b. Voltage regulation shall be ±0.5% for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed ±0.5%.
   c. Volts per hertz.
   d. Environmentally encapsulated.
   e. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed ±0.5%.
7. Generator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no third order harmonics or their multiples. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 40%.
8. Main line circuit breaker, sized to carry the rated output current of the generator set as indicated on the Drawings.
   a. Circuit breaker shall incorporate a thermal-magnetic trip unit with other overcurrent protection devices that protect the alternator under overcurrent conditions.
   b. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.
9. Provide 120VAC anti-condensation heater for the alternator.

C. Cooling System:

1. Unit-Mounted Radiator: Closed loop, self-contained liquid cooling complete with unit mounted radiator, pusher type fan, integral engine-drive coolant pump, thermostat and radiator duct flange. System shall be rated for full load operation in 122 degrees Fahrenheit ambient as measured at the alternator air inlet. Radiator shall be sized based on a core temperature that is 20 degrees Fahrenheit higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan system in a controlled environment. Size of radiator

shall be adequate to contain expansion of total system coolant from cold start to 110% load. Rotating parts shall be guarded against accidental contact.

2. Coolant: 50% ethylene-glycol-based antifreeze and 50% water, with anticorrosive additives as recommended by engine Manufacturer; good to -40 degrees C. Provide radiator coolant level sight glass and low coolant level safety shutdown.
3. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric. Hose shall be rated for 50-psig maximum working pressure with coolant at 180 degrees Fahrenheit, and non-collapsible under vacuum. End fittings shall be flanges or steel pipe nipples with clamps to suit piping and equipment connections.
4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
5. Temperature Control: Self-contained, thermostatic-control valve to modulate coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine Manufacturer.
6. Coolant Heaters: Thermostatically controlled, engine-mounted, 208-volt single phase; quantity and wattage as required to maintain coolant temperature as specified herein. Heaters shall be UL499 listed and labeled. Heaters shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12inches. Heater installation shall be specifically designed to provide proper venting of the system. Quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss. Heater shall be provided with a DC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system. Heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to the temperature required for starting and load pickup requirements as specified herein.

D. Exhaust System:
1. Critical (25-30 dBA reduction) grade silencer. Silencer shall be configured for interior installation in a vertical orientation.
2. Aluminized steelconstruction finished with high temperature paint.
3. ANSI 125/150# flanges.
4. Gas-proof stainless steel seamless flexible connector at engine connection.
5. Silencer condensate drain cock.
6. Provide ventilated thimbles at roof penetrations.
7. Provide stainless steel, counterweighted flipper-type rain cap on vertical exhaust discharge.
8. Silencer shall be mounted inside outdoor enclosure.
9. Thermal insulation blanket.
10. Mounting brackets, gussets, and lifting lugs.
11. Provide two 4-inch FNPT steel couplings or weld-o-lets welded to the exhaust stack for emissions testing. Couplings shall be located in the same horizontal plane, 90-degrees apart, 2 stack diameters from the stack discharge and 8 stack diameters from the nearest upstream disturbance in the exhaust stack. Furnish and install an NPT steel pipe plug for each test port prior to testing and reinstall pipe plugs after testing is complete.

E. Fuel System:
1. Flexible connection to unit.
2. Engine driven, mechanical, positive displacement fuel pump with primary fuel filter, water separator, and secondary fuel filter. Filters shall include replaceable canister elements.
3. Secondary gas regulator.
4. Manual gas shutoff valve.
5. D.C. solenoid valve wired to engine control panel for fuel shutoff.
6. Natural gas supply pressure for this project is 7-11 wc.
7. Low fuel pressure alarm.
8. Provide fuel connection ahead of building gas main shutoff.

F. D.C. Electric Starting System:
1. Heavy duty electric starting motor(s). Starting system shall be capable of 3 complete cranking cycles without overheating or recharging.

2. Battery rack and enclosure to prevent accidental contact with battery terminals.
3. Batteries shall be lead acid type, 24 volt DC, sized as recommended by the engine Manufacturer, complete with battery cables and connectors. Batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40 degrees Fahrenheit ambient temperature when fully charged.
4. Provide thermostatically-controlled 120VAC battery heater.
5. Provide a minimum 10 amp battery charger with automatic temperature compensation for each generator set battery bank. Generator sets incorporating 2 battery banks shall be provided with 2 chargers connected together and operating in parallel, with alarm output(s) connected in parallel. The charger(s) shall operate on 120VAC and include the following capabilities:
   a. Charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. Charger shall be UL-labeled with the maximum battery amp-hour rating that can be recharged within 24 hours. Label shall indicate that the charger is suitable for charging of 200AH batteries in accordance with the NFPA requirements.
   b. Charger shall incorporate a 4-state charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100% of charge, and a float stage to maintain a fully charged battery and supply battery loads when the generator set is not operating. In addition, charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.
   c. DC output voltage regulation shall be within ±1%. DC output ripple current shall not exceed 1amp at rated output current level.
   d. The charger shall include the following features:
      1) Two line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming.
      2) LED indicating lamp(s) to indicating normal charging condition (green), equalize charge state (amber), and fault condition (red).
      3) AC input over-current, over-voltage, and under-voltage protection.
      4) DC output over-current protection.
      5) Alarm output relay.
      6) Corrosion resistant aluminum enclosure.

G. Control and Instrument Panel:
1. Microprocessor-based control system designed to provide automatic starting, monitoring, and control of the generator set. System shall also include remote monitoring and control as specified herein.
2. Control panel shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set. Control panel shall be vibration isolated and prototype tested to verify durability of all components in system under vibration conditions encountered.
3. Control switches:
   a. MANUAL-OFF-AUTO selector switch.
   b. EMERGENCY STOP pushbutton (red mushroom head type).
   c. RESET pushbutton.
   d. LAMP TEST pushbutton.
4. Metering and monitoring:
   a. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW hours, and power factor. Generator output voltage shall be available in line to line and line to neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
   b. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.
   c. System shall monitor total load on generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. Display

hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.

d. System shall log total number of operating hours, total KWH, and total control on hours, as well as total values since reset.

5. High intensity LED alarm and status indicating lamps to identify the following functions:
   a. Five configurable indicating lamps; field adjustable for color and any status, warning, or shutdown function monitored by the generator set control system.
   b. Green lamps to indicate that generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. Running signal shall be based on actual sensed voltage and frequency on output terminals of generator set.
   c. Flashing red lamp to indicate that control is not in automatic state, and red common shutdown lamp.
   d. Amber common warning indication lamp.
6. Annunciator:
   a. Low oil pressure (warning).
   b. Low oil pressure (shutdown).
   c. Oil pressure sender failure (warning).
   d. Low coolant temperature (warning).
   e. High coolant temperature (warning).
   f. High coolant temperature (shutdown).
   g. High oil temperature (warning).
   h. Engine temperature sender failure (warning).
   i. Low coolant level (warning).
   j. Fail to crank (shutdown).
   k. Fail to start/overcrank (shutdown).
   l. Overspeed (shutdown).
   m. Low DC voltage (warning).
   n. High DC voltage (warning).
   o. Weak battery (warning).
   p. Low fuel day tank (warning).
   q. High AC voltage (shutdown).
   r. Low AC voltage (shutdown).
   s. Under frequency (shutdown).
   t. Over current (warning).
   u. Over current (shutdown).
   v. Short circuit (shutdown).
   w. Ground fault (warning) (optional when required by code or specified).
   x. Over load (warning).
   y. Emergency stop (shutdown).
   z. “System not in auto” (warning, flashing).
   aa. Four user configurable conditions.
   bb. All warning conditions shall also be field-configurable for shutdown. Last 10 warning or shutdown conditions shall be logged.
7. Engine status monitoring via a digital status panel:
   a. Engine oil pressure (psi or kPA).
   b. Engine coolant temperature (degrees F or C).
   c. Engine oil temperature (degrees F or C).
   d. Engine speed (rpm).
   e. Number of hours of operation (hours).
   f. Number of start attempts.
   g. Battery voltage (DC volts).
8. Control functions:
   a. Engine control.
      1) Cycle cranking system to allow for user selected crank time, rest time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
      2) Idle mode control to allow engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

3) Engine governor control to provide steady state frequency regulation as noted as specified herein. Governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while unit is starting.
4) Time delay start (0-300 seconds, adjustable) and time delay stop (0-600 seconds, adjustable).
5) Sender failure monitoring logic for speed sensing, oil pressure, and engine temperature. System shall be capable of discriminating between failed sender or wiring components, and an actual failure conditions.

b. Alternator control:
1) Full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. System shall be immune from mis-operation due to load induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. Voltage regulation system shall be equipped with three phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. System shall include a torque matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. Voltage regulator shall include adjustments for gain, damping, and frequency roll off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometer for system adjustments are not acceptable.
2) A microprocessor-based protection device shall be provided to individually monitor all phases of the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The device shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance with the requirements of NFPA 70, Article 445.
3) A microprocessor-based protection device shall be provided to monitor all phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance with the requirements of NFPA 70, Article 445.
4) Monitor KW load on generator set and initiate an alarm condition (over load) when total load on generator set exceeds generator set rating for more than 5 seconds. Include load shed control to operate a set of dry contacts when generator set is overloaded.
5) A microprocessor-based AC over/under voltage monitoring system that responds only to true RMS voltage conditions. System shall initiate shutdown of generator set when alternator output voltage exceeds 110% of operator-set voltage level for more than 10seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when output voltage of alternator is less than 85% for more than 10seconds. System shall monitor individual phases and be connected line to neutral on 3-phase 4-wire generator sets, and for systems that are solidly grounded.

c. Other:
1) Battery monitoring system shall be provided which initiates alarms when DC control and starting voltage is less than 25VDC or greater than 32 VDC. During engine cranking (starter engaged), low voltage limit shall be disabled and DC voltage shall be monitored as load is applied to battery to detect impending battery failure or deteriorated battery condition.
2) Networking/communications: Ethernet communications module. All engine and alternator data shall be communicated via connection. System shall allow for starting and stopping of generator set via connection in both test and emergency modes.
3) Four programmable output relays. Relay outputs shall be configurable for any alarm, shutdown, or status condition monitored. By default, relays shall be configured to indicate:
(a) Generator set operating at rated voltage and frequency.

(b) Common warning.
(c) Common shutdown.
(d) Load shed.

H. Outdoor Enclosure:
1. Weather-protected enclosure.
   a. Enclosure shall be insulated with non-hydroscopic materials.
2. Housing shall provide ample airflow for generator set operation at rated load in the specified ambient temperature. Housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.
3. Enclosure shall be constructed of minimum 12 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel.
4. All sheet metal shall be primed for corrosion protection and finish painted with neutral tan color, as selected by the architect. using a two-step electrocoating paint process, or equal process meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
   a. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
   b. Gloss, in accordance with ASTM D523, 80% ±5%. Gloss retention after 1 year shall exceed 50%.
   c. Crosshatch adhesion, in accordance with ASTM D3359, 4B-5B.
   d. Impact resistance, in accordance with ASTM D2794, 120-160 inch-pounds.
   e. Salt Spray, in accordance with ASTM B117, 1000+ hours.
   f. Humidity, in accordance with ASTM D2247, 1000+ hours.
   g. Water Soak, in accordance with ASTM D2247, 1000+ hours.
5. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable.
6. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.
7. A factory-mounted exhaust silencer shall be installed inside the enclosure. Exhaust shall exit the enclosure through a rain collar.
8. Enclosure shall include the following maintenance provisions:
   a. Flexible coolant and lubricating oil drain lines that extend to the exterior of the enclosure with internal drain valves.
   b. External radiator fill provisions.
9. Provide an external emergency stop switch that is protected from accidental actuation.
10. Provide motorized louvers to minimize air flow through the enclosure when generator set is not operating. Louvers shall include provisions to prevent accumulation of ice or snow that might prevent operation.
11. Inlet ducts shall include rain hoods.
12. Provide a remote emergency stop switch that is protected from accidental actuation and is installed at location indicated on the Drawings.

I. Connections:
1. Generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations. Sufficient lug space shall be provided for use with cables of the number and size as indicated on the Drawings.
2. Generator set control interfaces to other system components shall be made on permanently labeled terminal block assemblies. Labels describing connection point functions shall be provided.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ensure that all ventilation system equipment is operating properly.

3.2 INSTALLATION

A. Install engine generator system and associated equipment in conformance with the Shop Drawings reviewed by Engineer and the Manufacturer's recommendations.

B. General:
   1. Install engine generator sets where indicated, in accordance with the equipment Manufacturer's written instructions and recognized industry practices, to ensure that equipment complies with the requirements and serves the intended purposes.
   2. Provide concrete housekeeping pads. Equipment shall be permanently fastened to pad in accordance with Manufacturer’s instructions and seismic requirements of the Site.
   3. Install engine at sufficient height above pad to permit dropping of oil pan without removing unit.

C. Wiring and Connections:
   1. Provide conduit, wiring, and connections as required and recommended by equipment supplier.
   2. Make all conduit connections to generator set with flexible conduit.
   3. Connect neutral point of generator and generator frame to ground by insulated copper conductor sized in accordance with NEC.
   4. Connect motorized dampers for cooling air via auxiliary contacts on engine control panel.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's field service:
   1. Arrange and pay for Manufacturer's authorized representative to:
      a. Provide services indicated below.
      b. Minimum onsite time: 1 day(s).
      c. Additional time, as required.
   2. Schedule the following:
      a. As soon as practicable after installation. Schedule shall be coordinated with related Work.
      b. At times approved by Engineer and Owner.
   3. Manufacturer's representative:
      a. Check work.
      b. Provide startup services as recommended by Manufacturer, including all items listed in commissioning, acceptance testing, and startup procedures, instructions, and guidelines.
      c. Assist with testing.
      d. Demonstrate operation and maintenance of equipment to Owner's personnel.
      e. Review operation and maintenance manual with Owner's personnel. Two 2-hour review sessions shall be scheduled to coordinate with schedules of Owner's personnel (i.e., day/morning and afternoon/evening shifts). Each review session shall accommodate up to 8 individuals. Submit detailed outline for each review session prior to scheduling.
      f. Owner reserves the right to video record review sessions. Video recording will be done by Owner.
   4. Promptly make all changes and additions required by Manufacturer's representative.

B. Field Performance and Functional Testing:
   1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the Manufacturer's recommendations under the environmental conditions present and expected.
   2. Accessories that normally function while the generator set is standing by shall be checked prior to cranking the engine. This shall include: engine heaters, battery charger, generator strip heaters, remote annunciator, etc.
   3. Performance Testing to be performed by Contractor:
      a. All test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Calibration records shall be available for examination upon request.
      b. Perform visual, mechanical, and electrical inspections and testing for generators as specified in the latest edition of NETA Acceptance Testing Specification (ATS). Certify compliance with

test parameters. Perform additional tests as required by NFPA 110, including, but not limited to, single-step full-load pickup test.

c. Battery Tests: Equalize charging of battery cells according to Manufacturer's written instructions. Record individual cell voltages.
d. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
e. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for battery.
f. Verify acceptance of charge for each element of battery after discharge.
g. Confirm that measurements are within Manufacturer's specifications.
h. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
i. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks and excessive vibration.
j. Exhaust System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back-pressure at full-rated load is within Manufacturer's written allowable limits for engine.
k. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100% step-load increases and decreases, and verify that performance is as specified.

4. Functional Testing to be performed by Contractor:
   a. Start up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.
   b. Automatic startup by means of simulated power outage to test remote-automatic starting, transfer of load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine temperature, oil pressure and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the testing. Testing to be conducted from each transfer switch in the system.

3.4 FUEL AND FLUID TOP OFF

A. Upon successful completion of testing, Contractor shall top off all fluid levels.

3.5 CLEANING

A. Clean materials installed under this Section in accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION

SECTION 26 36 23 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of transfer switches.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. IEEE 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications; 1995.
   2. NEMA ICS 1 - Industrial Control and Systems General Requirements; 2022.
   3. NEMA IA 10042-1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2025.
   4. NFPA 70 - NATIONAL ELECTRICAL CODE; ALL.
   5. NFPA 99 - Health Care Facilities Code; 2024, with Errata.
   6. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.
   7. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.4 SYSTEM DESCRIPTION

A. Standby System Automatic Operation:
   1. Initiate engine generator starting upon loss of normal electrical power.
   2. Transfer Load To Generator:
      a. Automatically.
      b. When generator reaches rated voltage and frequency.
      c. Within 60 seconds of loss of normal electric power.
   3. Retransfer Load To Normal Electric Power: Automatically.
   4. Initiate engine generator shutdown.

B. All change-in-system status functions are subject to adjustable time delays as specified herein.

C. All automatic load transfers shall occur after a time delay with transfer switch in a "neutral-off" position.

1.5 SUBMITTALS

A. Shop Drawings:
   1. Name of Manufacturer.
   2. Model number.
   3. Details of construction and installation.
   4. Assembly drawings, including elevations, plans, sections, dimensions, weight, and conduit entry locations.
   5. Project Specific Wiring Diagrams:
      a. Diagrams shall clearly identify all field wiring requirements between generator set(s), transfer switch(es), and other remote devices.

6. Connection points shall be identified by terminal number.
7. Electrical Ratings:
   a. Voltage.
   b. Amperage.
   c. Poles.
   d. Withstand and closing rating.
   e. Enclosure type.
8. Color and finish.
9. Options and accessories.

B. Operation and Maintenance Manuals:
   1. Equipment function, normal operating characteristic and limiting conditions.
   2. Assembly, installation, alignment, adjustment, and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown, and emergency conditions.
   4. Maintenance instructions.
   5. Guide to "troubleshooting."
   6. Parts lists and predicted life of parts subject to wear.
   7. Project specific outline and cross-sections, assembly drawings, engineering data, and wiring diagrams. Wiring diagrams shall reflect final, as-installed conditions and include wire numbers.
   8. Test and performance data as applicable.
   9. Warranty information, clearly indicating starting and ending dates.

C. Manufacturer’s Installation Instructions: Include recommended commissioning, acceptance testing, and startup procedures, instructions, and guidelines.

D. Test Reports: Performance and functional testing and startup results.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.

B. Manufacturer's Services:
   1. Provide Manufacturer's field service for start-up and testing.
   2. Provide Manufacturer's authorized service organization within 100 miles of Site.

C. Testing:
   1. Provide factory performance testing of assembled transfer switch prior to shipment.
   2. Provide field load functional testing prior to acceptance.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Transfer Switches:
1. ASCO.
2. Eaton Corporation.
3. ABB Zenith.
4. Russelectric.
5. Generator Manufacturer.

2.2 EQUIPMENT RATING

A. Transfer Switches:
1. Cycle Rating: Time-Based ("Any Breaker", 3-Cycle).
2. Ampere: As indicated on Drawings.
3. Poles: As indicated on the drawings.
4. Ampere Withstand and Closing Rating: As indicated on the Drawings.65 KA (minimum) RMS symmetrical minimum when not listed.
5. Enclosure: NEMA 1, powder coated steel.

B. Line and Load Side Lugs:
1. Transfer switch manufacturer to review the Drawings for line side and load side conduit and conductor requirements. Manufacturer shall provide lugs capable of accepting conductor sizes as shown.
2. All accessories required to accept conductors sizes shown are to be factory installed.
a. If the transfer switch manufacturer requires field installation, the transfer switch manufacturer shall include the field services of one of their engineers/representatives to install the required accessories, have the equipment field listed by UL, and maintain the original warranty of the equipment.
b. Alternatively, the transfer switch manufacturer may, with approval from the Engineer, pay the Contractor to install conduit and conductors of the configuration required to terminate to the transfer switch. Where new conductors are being installed, conductor installation shall be continuous from equipment upstream to transfer switch or from transfer switch to equipment being fed. Splicing of conductors will not be permitted. Splicing of existing conductors to be reused will be permitted as required.

2.3 TRANSFER SWITCHES

A. General:
1. Solid-state controls: Repetitive accuracy of all settings shall be ±2% or better over an operating temperature range of -20 to +70 degrees C.
2. Resistance to damage by voltage transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
3. Electrical operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
4. Switch characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
a. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
b. Switch Action: Double throw; mechanically held in both directions.
c. Contacts: Silver composition or silver alloy for load-current switching. Conventional transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
5. Neutral terminal/bus: Solid and fully rated.
6. Factory wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations.

a. Designated terminals: Pressure type, suitable for types and sizes of field wiring indicated.
b. Control wiring: Equipped with lugs suitable for connection to terminal strips.

7. Power Terminals:
   a. Sized to accept conductors sizes as indicated on the Drawings.
   b. Suitable for top enterance of feeder conductors. Conractor is responsible for coordinating wire entry requirements.

B. Automatic Transfer Switches:
1. Switching arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated or specified.
2. Manual switch operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
3. Signal-before-transfer contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval to be adjustable from 1 to 30 seconds.
4. Transfer switches based on molded case switch components: are not permitted.
5. Programmed neutral-off switch position: Switch operator has a programmed neutral-off position arranged to provide a midpoint between 2 working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
6. Control features:
   a. Undervoltage sensing for each phase of normal source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100%t of nominal, and dropout voltage adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.
   b. Adjustable time delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from 0 to 6 seconds, factory set for 1 second.
   c. Voltage/Frequency lockout relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
   d. Time delay for retransfer to normal source: Adjustable from 0 to 30 minutes, factory set for 10minutes to automatically defeat delay on loss of voltage or sustained undervoltage of standbysource, provided normal supply has been restored.
   e. Test switch: Simulate normal source failure.
   f. Switch position indicating lights: Indicate source to which load is connected.
   g. Source available indicating lights: Supervise sources via transfer-switch normal and standby source sensing circuits.
      1) Normal power supervision: Green light with nameplate engraved "Normal Source Available."
      2) Standby power supervision: Red light with nameplate engraved “ Standby Source Available."
   h. Auxiliary contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240VAC.
   i. Transfer override switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to standby power source regardless of condition of normal source. Indicating light indicates override status.
   j. Engine-generator starting contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32VDC minimum.
   k. Engine-generator shutdown contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
   l. Engine-generator shutdown contacts: Time delay adjustable from 0 to 5 minutes, factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
   m. Engine-generator exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfer and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory

settings for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
1) Exerciser transfer selector switch: Permits selection of exercise with and without load transfer.
2) Push-button programming control with digital display of settings.
3) Integral battery operation of time switch when normal control power is not available.

7. Communications Interface – Transfer switch shall be capable of interfacing, through an optional communications interface module, with a network. It shall be able to connect via an Ethernet connectivity module This module shall allow for seamless integration of existing or new communication transfer devices. Standard software specific for transfer switch applications shall be provided with the transfer switch. Software shall allow for monitoring, control, and setup of parameters. Transfer switch shall also be able to interface to 3rd party applications using Modbus/TCPopen standard protocols.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the transfer switches in conformance with:
1. The Shop Drawings reviewed by Engineer.
2. The Manufacturer's recommendations.

B. General: Install transfer switches where indicated, in accordance with the equipment Manufacturer's written instructions and with recognized industry practices, to ensure that the units comply with the requirements and serve the intended purposes.

C. Wiring and Connections: Provide conduit, wiring, and connections required and recommended by unit supplier.

3.2 FIELD QUALITY CONTROL:

A. Manufacturer's field service:
1. Arrange and pay for Manufacturer's authorized representative to:
a. Provide services indicated below.
b. Minimum onsite time: 2 day(s).
c. Additional time, as required.
2. Schedule the following:
a. As soon as practicable after installation. Schedule shall be coordinated with related Work.
b. At times approved by Engineer and Owner.
3. Manufacturer's representative:
a. Check work.
b. Provide startup services as recommended by Manufacturer, including all items listed in commissioning, acceptance testing, and startup procedures, instructions, and guidelines.
c. Assist with testing.
d. Demonstrate operation and maintenance of equipment to Owner's personnel.
e. Review operation and maintenance manual with Owner's personnel. Two 2-hour review sessions shall be scheduled to coordinate with schedules of Owner's personnel (i.e., day/morning and afternoon/evening shifts). Each review session shall accommodate up to 8 individuals. Submit detailed outline for each review session prior to scheduling.
f. Owner reserves the right to videotape review sessions. Videotaping will be done by Owner.
4. Promptly make all changes and additions required by Manufacturer's representative.

B. Field Performance and Functional Testing:
1. Functional Testing to be performed by Contractor:
a. Automatic start-up of generator and switchover by means of simulated power outage to test remote-automatic starting, transfer of load, and automatic shutdown. Prior to this test, all

transfer switch timers shall be adjusted for proper system coordination. Testing to be conducted from each transfer switch in the system.

3.3 ADJUSTING:

A. Time delay, voltage and frequency sensing for each transfer switch shall be adjusted or re-adjusted, or both, to maximize system reliability.

END OF SECTION

SECTION 26 43 05 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of surge protective devices (SPD).

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ANSI C84.1 - American National Standard for Electric Power Systems and Equipment -- Voltage Ratings (60 Hz); 2020 (Reaffirmed 2025).
   2. IEEE C62.41.1 - IEEE Standard Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits; 2002 (Reaffirmed 2008).
   3. IEEE C62.45 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits; 2002.
   4. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.
   5. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Shop Drawings: For Surge Protective Devices.
   1. Name of Manufacturer.
   2. Model number.
   3. Details of construction and installation.
   4. Test data:
      a. Provide UL 1449 (5th Edition) data card showing the Voltage Protection Rating (VPR) and “Engineering Considerations” for the specific catalog number submitted.
      b. In accordance with NEC Article 285.6, the devices shall be marked with the short circuit current rating. This rating shall meet or exceed the available fault current. Provide test data to demonstrate the short circuit current rating has been tested on a complete device.
      c. Submit test report data, which clearly demonstrates that the maximum surge current rating has been tested on a complete SPD unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems.
      d. Submit data, which demonstrates that the SPD unit is capable of surviving the specified minimum repetitive surge current rating. The rating is based on surviving a specified number of ANSI/IEEE C62.41, Category C3 (10kA) impulses without failure or degradation in performance characteristics of more than 10%.
   5. Provide detailed written comments for each paragraph of the specification indicating that the proposed product meets or exceeds this specification. Where products do not meet the specific requirements, provide a written explanation.
   6. Dimensional data.

B. Installation Instructions: For surge protective devices.

C. Operation and Maintenance Manuals: For surge protective devices.
   1. Equipment function, normal operating characteristics, and limiting conditions.

2. Assembly, installation, alignment, adjustment, and checking instructions.
3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
4. Maintenance instructions.
5. Guide to "troubleshooting".
6. Parts list and predicted life of parts subject to wear.
7. Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams.
8. Test data and performance curves.
9. Warranty information clearly indicating start and end dates.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed submittals.
3. Firms that have regularly engaged in the development, design, testing, listing and manufacture of surge protective devices for 10 years or more.

B. Regulatory Requirements: All surge protective devices shall meet or exceed the requirements of UL 1449 (5th Edition) and be listed accordingly.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer’s directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation.

B. Schneider Electric; Square D.

C. Siemens Energy & Automation, Inc.

D. ABB.

E. Liebert.

F. Advanced Protection Technologies Inc. (APT).

G. Transtector, Inc.

2.2 PRODUCT REQUIREMENTS

A. The units shall be engineered, solid-state, high-performance, surge protective devices.

B. Protection Modes: All modes shall be protected:
   1. Normal: Line-Line (L-L), Line-Neutral (L-N).
   2. Common: Neutral-Ground (N-G), Line-Ground (L-G).

C. The Manufacturer shall provide surge protective devices that are classified by UL 1449 (5th Edition) as Type1 devices. All protective elements shall be included within the SPD enclosure.

D. The ANSI/UL 1449 Nominal Discharge Current Rating shall be a minimum of 20kA.

E. Unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.

F. Unit shall have a Form C summary alarm output contact rated for at least 1 ampere at 120 VAC for remote annunciation of SPD status.

2.3 SERVICE ENTRANCE SPD

A. Maximum UL 1449 (5th Edition), Voltage Protection Rating (VPR):
   1. 208Y/120V and 120/240V Systems:
      a. L-N:700V.
      b. L-G:700V.
      c. N-G:700V.
      d. L-L:1000V.
   2. 480Y/277 Volt Systems:
      a. L-N:1000V.
      b. L-G:1200V.
      c. N-G:1000V.
      d. L-L:1800V.
   3. 240V Systems:
      a. L-G:1200V.
      b. L-L:1000V.
   4. 480V Systems:
      a. L-G:1800V.
      b. L-L:1800V.

B. The service entrance SPD shall be capable of surviving 15,000 ANSI/IEEE, Category C3 (10kA) impulses without failure or degradation of original performance characteristics of more than 10%.

C. Maximum surge current rating shall be as indicated on the Drawings, based on ANSI/IEEE C62.41 standard 8x20ms current waveform.

D. Unit shall include a built-in, push-to-test feature that tests the integrity of all modules, MOVs and fuses in the system.

E. Options:
   1. Unit shall have an audible alarm with an alarm on/off switch to silence the alarm and a push-to-test switch to test the alarm function.
   2. A resettable counter shall be provided to totalize transient voltage surges in both the normal and common mode. The readout shall be at least a 6-digit LCD located on the unit front cover and equipped with a 10-year battery back-up to maintain counts in the event of a power loss.

F. Warranty: Manufacturer shall provide a product warranty for period of not less than 10 years from date of installation. Warranty shall cover unlimited replacement of system protection modules during warranty period. The first 5 years of this warranty will include field labor required to perform repair or replacement work.

2.4 BRANCH PANEL SPD

A. Maximum UL 1449 (5th Edition), Voltage Protection Rating (VPR):
   1. 208Y/120V and 120/240V Systems:
      a. L-N:600V.
      b. L-G:700V.
      c. N-G:600V.
      d. L-L:900V.
   2. 480Y/277 Volt Systems:
      a. L-N:1000V.
      b. L-G:1000V.
      c. N-G:900V.
      d. L-L:1800V.
   3. 240V Systems:
      a. L-G:1000V.
      b. L-L:1200V.
   4. 480V Systems:
      a. L-G:1800V.
      b. L-L:1800V.

B. The branch panel SPD shall be capable of surviving 6,000 ANSI/IEEE, Category C3 (10kA) impulses without failure or degradation of original performance characteristics of more than 10%.

C. Maximum surge current rating shall be as indicated on the Drawings, based on ANSI/IEEE C62.41 standard 8x20ms current waveform.

D. The SPD shall be connected to the panelboard bus bar through a dedicated 30 amp breaker provided by the equipment manufacturer.

E. Warranty: Manufacturer shall provide a product warranty for a period of not less than 5 years from date of installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install surge protective devices in conformance with:
   1. The submittals reviewed by Engineer.
   2. The Manufacturer’s recommendations.

B. For new construction, SPD devices may be installed internal to the electrical distribution equipment. Phase, neutral, and ground connection leads shall be as short as possible and not greater than 14 inches in length.

C. Provide all labor, materials, equipment and services necessary for and incidental to the installation of the SPD system components as specified herein.

D. Verify system voltages, phases, etc. to ensure the proper application of the surge protective device and coordinate with upstream and downstream transient suppression devices. Assure that all neutral

conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated surge protective devices.

3.2 FIELD QUALITY CONTROL

A. Ensure that the installed length of conductor leads is not greater than the length at which the SPD device was tested. Lead length is defined as the length of the lead between the SPD device enclosure exterior to the connection point.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all lighting and the major items listed below:
   1. Interior luminaires.
   2. Exterior luminaires.
   3. Drivers.
   4. LEDs installed in luminaires.
   5. Lamps installed in luminaires.
   6. Exit signs.
   7. Luminaire supporting systems.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
   2. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
   3. IES TM-15 - Luminaire Classification System for Outdoor Luminaires; 2020.
   4. IES TM-21 - Projecting Long-Term Luminous, Photon, and Radiant Flux Maintenance of LED Light Sources; 2021.
   5. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   6. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   7. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
   8. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
   9. UL 1598 - Luminaires; Current Edition, Including All Revisions.
   10. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See “Luminaire.”

D. IP: International Protection or Ingress Protection Rating

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

H. Useful Life (For LED Luminaire Light Source) - The operating hours before reaching 70% of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70% "Rated Lumen Maintenance Life" as defined in IES TM-80.

1.5 SUBMITTALS

A. Shop Drawings:
   1. For luminaries, submit the following:
      a. Luminaire designation.
      b. Name of Manufacturer.
      c. Model number.
      d. Details of construction and installation.
      e. Dimensions and rough-in requirements.
      f. Voltage.
      g. Photometric data and adjustment factors based on laboratory tests.
      h. Driver Data:
         1) Name of Manufacturer.
         2) Model number.
         3) Operating characteristics.
      i. Wiring diagrams.
      j. Color and finish.
      k. Options and accessories.
   2. For Exterior LED Luminaires, submit the following:
      a. LED Luminaire – IES LM-79 Test Report.
      b. LED Luminaire – IES LM-80 Test Report.
      c. Provide long term lumen maintenance projections for each LED luminaire in accordance with IESTM-21. Data used for projections shall be obtained from testing in accordance with IES LM-80.
      d. Effective projected area (EPA).
   3. For Interior LED Luminaires, submit the following:
      a. Life, output (lumens, CCT, and CRI), and energy efficiency data.
      b. LED Luminaire – IES LM-79 Test Report.
      c. LED Luminaire – IES LM-80 Test Report.
      d. Provide long term lumen maintenance projections for each LED luminaire in accordance with IESTM-21. Data used for projections shall be obtained from testing in accordance with IES LM-80. According to IES TM-21, "Reported" values are restricted to 5.5x or 6x (depending on sample size) the duration of IES LM-80 testing, whereas "Calculated" (i.e., projected) values are unrestricted. Manufacturer shall indicate whether TM-21 data is "Reported" or "Calculated".

B. Certificates:
   1. Luminaire Useful Life Certificate: Submit certification from the manufacturer indicating the expected useful life of the luminaires provided. The useful life shall be directly correlated from the IES TM-80 test data using procedures outlined in IES TM-21. Thermal properties of the specific luminaire and local ambient operating temperature and conditions shall be taken into consideration.

C. Operation and Maintenance Manuals: For Luminaires.
   1. Equipment function, normal operating characteristics, and limiting conditions.
   2. Assembly, installation, alignment, adjustment, and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
   4. Maintenance instructions.
   5. Guide to "troubleshooting."
   6. Parts list and predicted life of parts subject to wear.

7. Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams.
8. Test and performance curves.

D. Record Drawings: Submit 2 copies to Owner identifying maintenance and lamp replacement requirements.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed submittals.

B. All equipment shall be UL listed.

1.7 WARRANTY

A. In accordance with the warranty provisions defined in the General Conditions and Supplementary Conditions:
1. LED Luminaires:
a. Provide 5 year manufacturer warranty for all LED luminaires, including drivers, luminaire housing, wiring, and connections.
b. Loss of 10% or more of light output from the LED sources in an LED luminaire during the warranty period constitutes luminaire failure.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer’s directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 LUMINAIRE TYPES

A. Furnish products as indicated in Luminaire Schedule on the Drawings.

B. Substitutions: In accordance with Division 01 Section “Product Substitution Procedures.”

2.2 MATERIALS

A. General:
1. Furnish luminaires with all trims and accessories required for the various types of ceiling and wall construction.
2. Provide "damp" or "wet" location labels on all luminaires installed outdoors and in damp or wet interior locations.
3. All recessed luminaires shall be thermally protected.

4. All troffers shall be painted after fabrication.
5. Exterior LED luminaires shall be rated for operation within an ambient temperature range of -40-degreesC to 40-degrees C.
6. Interior LED luminaires shall be rated for operation at an average ambient temperature of 25 degrees C.

B. Exit Signs:
1. Description: Internally illuminated exit signs with LEDs, unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
2. Provide exit signs as indicated on the Luminaire Schedule.
3. Exit signs shall have minimum of 6-inch high letters.
4. Number of faces: Single or double as indicated or as required for the installed location.
5. Directional Arrows: As indicated or as required for the installed location.

C. LED Luminaires:
1. Correlated Color Temperature (CCT) shall be in accordance with NEMA ANSI ANSLG C78.377 – Specifications for the Chromaticity of Solid State Lighting Products.
2. LED Power Supply Units (Drivers): Minimum efficiency shall be 85%.
3. Exterior LED Luminaires shall meet the performance requirements specified in ANSI C136.2 for electrical immunity, using the enhanced combination wave form test level (10kV/5kA).
4. Provide 0 to 10V dimming driver as indicated on the Luminaire Schedule. Dimming range shall be as noted on the Luminaire Schedule.
   a. Shall be rated to operate between ambient temperatures of -22 degrees Fahrenheit and 104 degrees Fahrenheit.
   b. Shall be designed to operate on the voltage system to which they are connected.
   c. Operating frequency shall be 60 Hz.
   d. Power factor (PF) shall be greater than or equal to 0.90.
   e. Shall be RoHS-compliant.
   f. Shall be mounted integral to luminaire. Unless indicated otherwise, remote mounting of power supply is not allowed.
5. LED Luminaire Surge Protection: Provide surge protection integral to luminaire to meet C Low waveform as defined by IEEE C62.41.2, Scenario 1, Location Category C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that outlet boxes are installed in proper locations at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

B. Verify that suitable support frames are installed where required.

C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

D. Verify that conditions are satisfactory for installation prior to starting Work.

3.2 PREPARATION

A. Examine all pertinent details (architectural and otherwise) in the Contract Documents that are relevant to the installation of luminaires.

B. Provide extension rings to bring outlet boxes flush with finished surfaces.

C. Remove all dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. General:
   1. Install surface mounted, recessed, or semi-recessed luminaires to maintain the alignment, spacing, layout, and general arrangement indicated on the Drawings.
   2. Obtain approval of Engineer for all proposed changes that may be required due to field conditions and/or to avoid conflicts with Work by other trades.
   3. Install all luminaires in accordance with Manufacturer's recommendations.
   4. Equip all luminaires with the specified quantity of functional lamps prior to Substantial Completion.
   5. Unless noted otherwise, all wiring for LED luminaires that are required to be dimmed shall include two #18 AWG control wires from each luminaire driver to the associated lighting controller for 0-10V lighting control. All control wires shall be labeled. Coordinate exact requirements with lighting control Shop Drawings.
   6. Install all wiring for emergency lighting and exit signs that are not local battery powered in a raceway system independent from other building wiring.
   7. In the installation of exterior luminaires, take care to maintain symmetry with existing installation, while conforming to the Drawings.

B. Coordination:
   1. Coordinate locations of recessed and surface mounted luminaires in ceiling systems with Division 09.
   2. Locate luminaires according to the reflected ceiling Drawings, if furnished.
   3. Coordinate location of luminaires in Mechanical, HVAC,and Plumbing areas with other trades.
   4. Notify Engineer of field conditions that contradict Drawings or Specifications prior to beginning work.
   5. Coordinate space conditions that contradict or conflict with Work by other trades before installing luminaires.

C. Mounting and Support:
   1. Recessed Luminaires:
      a. Wire luminaires that are mounted in or on the underside of lay-in ceilings with flexible conduit to an outlet box on the rigid conduit system above, such that the rigid conduit system does not interfere with the removal of lay-in ceiling panels or luminaires.
      b. Do not support luminaires directly on ceiling panels.
      c. Install a minimum of four ceiling support system rods or wires for each luminaire. Locate rods or wires not more than 6-inches from the corners of each luminaire
      d. Support Clips: Fasten to each luminaire and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
      e. Securely mount luminaires and electrical boxes to elements of the building structure such that luminaires will be square, plumb, and rigid; and will not fall or sag, and will not cause the suspended ceiling system to fall or sag.
      f. Install at least one independent support rod or wire from structure to a tab on each luminaire. Wire or rod shall have a breaking strength equal to the weight of luminaire plus a safety factor of3.
      g. Provide all additional means (metal plates, etc.) necessary to support luminaires that would put excessive stress on the ceiling system.
   2. Surface Mounted Luminaires:
      a. Securely mount luminaires and electrical boxes to elements of the building structure such that luminaires will be square, plumb, and rigid; and will not fall or sag, and will not cause the ceiling system to fall or sag.
      b. Provide all additional means (metal plates, plywood backing, expansion bolts, toggle bolts, etc.) necessary to support luminaires that would put excessive stress on the ceiling system.

3.4 FIELD QUALITY CONTROL

A. Test all luminaires and lighting controls for proper operation.

B. All luminaires shall operate properly.

C. Adjusting and Aiming:
   1. All final adjusting and aiming of luminaires (such as focusing all adjustable luminaires) shall be done during the night hours. Contractor shall prearrange time with Engineer so Engineer can be present. Final adjustments shall be made as directed in field by Engineer.
   2. Replace all defective luminaires immediately prior to Substantial Completion.

3.5 CLEANING

A. Clean all luminaire trims, exposed housings, doors, lenses, and reflectors immediately prior to Substantial Completion.

END OF SECTION

SECTION 27 01 00 - OPERATION AND MAINTENANCE OF COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. This section is inclusive to all Division 27 sections.

1.2 DRAWINGS

A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.

B. All work shall be subject to the Owner's direction and approval.

1.3 SUMMARY

A. This project consists of providing a complete structured cabling system for the new Community Center at Van Buren Township. The structured cabling system includes voice and data cabling locations as shown on the drawings for this building. This building shall be connected to the city's network via local public services.

B. The scope of work includes:
   1. Provide all voice and data throughout as a total end-to-end solution as described within the Division 27 documents and as shown on the "T" series drawing sheets.
      a. Provide the necessary parts and supplies whether specifically mentioned or not to turn over to the Owner a complete system.

1.4 QUALITY ASSURANCE

A. In addition to procedures stated in Division 1:
   1. Cutting and Patching
      a. Perform required cutting, drilling, and chasing to receive new equipment. In general, perform all patching and repairing necessary to restore to original condition, all surfaces that may become damaged during the installation. All work shall be executed by persons normally employed in the type of work to which they are assigned.
      b. Paint all structural steel and all steel parts used for hangers and for supporting conduits, junction boxes, and technology equipment with one (1) coat of "red" oxide primer before erection. After steel is in place, paint again with a minimum of one (1) coat of paint, color as directed by the Architect.
      c. The Contractor is responsible for all cutting, patching, plastering, and painting associated with the new installation.
   2. Clean Up
      a. The job-site shall be cleaned at the end of each day.
      b. Upon completion of the contract, remove all workmen's appurtenances from the premises. Clean the premises of all debris caused by the work and leave the installation clean and in first-class operating condition.
   3. Storage of Material and Equipment
      a. Store materials and equipment in a location approved by the Owner.
      b. Be responsible for securing all equipment and materials employed in the installation until final acceptance by the Owner. The Owner shall not be responsible for loss reimbursement to the Contractor.

c. Be responsible for the replacement of all damaged or defective work, materials, or equipment. Do not install sensitive or delicate equipment until major construction work is completed. Ensure that equipment is protected from all construction site activities.
d. Observe and conform to all applicable safety regulations required by the Owner and OSHA.

1.5 INTERPRETATION AND CONFLICTS

A. Bring any discrepancies determined or omissions found lacking in the Contract Documents to the Technology Consultant's attention before submitting the bid. After award of Contract, the Owner or Technology Consultant shall make the interpretation of any conflict.

B. The failure to question any controversial item shall constitute acceptance by the Bidder who shall execute it to the satisfaction of the Owner after being awarded the Contract.

C. If mention has been omitted pertaining to details, items or related accessories required for the completion of any system, it is understood such item and accessories are included in the Contract. After the Contract is awarded, claims based on insufficient data or incorrectly assumed conditions, or claims based on misunderstanding the nature of the work, shall not be recognized.

D. The General Conditions, Requirements, and Special Provisions, of any larger body of specifications, of which this Specification may be a part, are hereby made a part of this Specification. In the event that any clauses or provisions of the larger body of specification conflict with the letter or intent of this Specification, the Contractor shall immediately notify the Architect and the Technology Consultant for clarification and direction.

E. All work shown shall be new work provided under this Contract except that work labeled "present to remain" and that equipment labeled "to be furnished by others but installed by the Contractor."

1.6 LABELING AND IDENTIFICATION

A. Clearly Label all new equipment, devices, and miscellaneous apparatus for easy identification and for safety.

B. Owner shall identify and provide labeling schemes for all patch panels, wall plate end point locations, 110 blocks, fiber termination cabinets, and backbone cables according to Owner's standards.

1.7 LOCATION OF EQUIPMENT AND RACEWAY

A. The drawings are diagrammatic and indicate the general arrangement of equipment to be installed.

B. Coordinate the structural, electrical/electronic, and finished conditions of work accordingly.

C. Coordinated locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site. Install all items to accommodate the various conditions in the building and make deviations necessary without additional cost.

1.8 WIRING METHODS

A. Install all wire and cable located in finished areas in new or existing raceways as indicated on Drawings.

B. Install new raceways in the locations shown on the drawings and as specified.

1.9 ORDINANCES AND CODES

A. Nothing contained in the Specifications or shown on the drawings shall be construed as to conflict with any local, municipal or state laws and regulations, governing the installation or other contract work, and all such ordinances and regulations, including the latest: National Electric Code, TIA standards and the National Electric Safety Code, are hereby incorporated and made a part of these Specifications, and shall be satisfied by the Contractor at no additional expense to the Owner.

B. Secure all permits and inspection certificates for submission to the Owner.

1.10 SYSTEM CONTINUITY

A. Reconnect all existing items that remain in use. Provide all materials and labor required to retain continuity of existing circuits or systems that are disrupted by these alterations even though not indicated on the drawings.

1.11 SUBMITTALS

A. Shop drawings shall be checked, corrected, and approved by the Contractor before being submitted to the Owner/Technology Consultant for review. Before submitting shop drawings, the Contractor shall carefully examine them and shall certify by his stamp/signature that, to the best of his knowledge, they comply with the Contract Documents. The Contractor must receive written approval from the Owner or an authorized representative of the Owner, in writing, prior to fabricating or installing any materials. Approval shall be given based upon shop drawings. The shop drawings shall indicate complete details of work to be performed. Drawings shall include a title block naming the Project, Architect, Technology Consultant, Contractor, drawing title, drawing number, revision number if applicable and date. Submit all Shop Drawings complete as a single submission. Isolated items shall not be accepted, except with prior approval.

B. Where the shop drawings deviate from the requirements of the Contract documents, the Contractor shall (1) correct the shop drawings as required, or (2) where the deviations do not necessarily require correction, notify the Owner/Technology Consultant of the deviations.

C. Submit to the Architect four (4) sets of shop drawings or otherwise documents/equipment for the following equipment and obtain written approval before ordering materials. See the drawings and scope information for applicability of product to phase and project.

D. The Contractor shall provide product submittals for all system components as defined in Part 2 of all associated communication specification sections related to this project. These components shall include:
   1. Patch Panels (UTP and Fiber)
   2. Cables (UTP and Fiber)
   3. Patch Cables (UTP and Fiber)
   4. Faceplates and Jacks
   5. Proposed Labeling Scheme
   6. Cable Management Devices
   7. Innerduct
   8. Punch Down Blocks
   9. Protection Devices
   10. Grounding and Bonding Equipment
   11. Racks and Cabinets
   12. Nameplates and Identification Devices
   13. Basket Style Cable Tray
   14. Ladder Style Cable Tray
   15. Hangers and Supports
   16. Strain Relief Products
   17. All other equipment identified or inferred as may be required by the Architect, Technology Consultant or Owner.

E. Submit complete submittal list for Architect/Technology Consultant review prior to purchasing any equipment.

F. Where multiple products are shown on one cut sheet, circle product to be used.

G. The selected Contractor shall allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant.

H. In some cases, manufacturer warranty may call for the review of system documentation to assure that the system design meets manufacturer warranty requirements. In such instance, with prior approval of the Owner, the Contractor shall provide a complete set of Project Documents and product data to the system manufacturer for review. The system manufacturer shall review the complete system package and provide documentation attesting to the system compliance with manufacturer warranty requirements. This documentation shall be included with the Contractor Shop Drawings submittal. The Technology Consultant shall not review the Contractor Shop Drawings submittal, which does not include the manufacturer warranty compliance review documentation.

I. Isolated items shall not be accepted, except with prior approval

J. Each shop drawing shall contain reference to the applicable drawing and specification section and verification of compatibility with the systems involved.

K. All nameplate data shall be submitted with equipment submittals – refer to other sections for complete identification requirements.

L. Shop drawings shall show conformance with specified performance characteristics, or the Contractor shall assume responsibility for all deviations including all additional costs as a result of the deviations.

1.12 STANDARDS OF MATERIAL AND WORKMANSHIP

A. All work shall be executed by persons skilled in the work to which they are assigned. This shall include all copper and fiber connections including testing, and all plastering and painting.

B. All materials and equipment in the work shall be new and of first quality, produced by manufacturers of recognized reputation for each line of material and equipment. The fact that materials or equipment offered have been recently developed or are untried may be sufficient justification for their rejection.

1.13 PROTECTION OF WORK AND EQUIPMENT

A. This Contractor shall use the required safety precautions, methods, and skills to prevent possible unsafe conditions or conditions unduly susceptible to fire.

B. When this Contractor is working in areas in which the building occupants have access, Contractor shall provide suitable barriers around his operation.

C. This Contractor is responsible for containing the undue spread of vapors or odors from his work area.

1.14 TESTS AND INSTRUCTIONS

A. Upon completion of the work, and upon the request of the Architect, the Contractor shall be prepared to test all systems in the presence of the Owner, Architect, or Technology Consultant. Such testing shall occur at a time that is mutually acceptable to all parties. The Contractor's representatives assisting in the

performance of these tests shall be thoroughly familiar with the details of the system and shall include the field supervisor responsible for installing the system.

B. The Contractor shall provide the Owner with all manufacturers' systems certifications within 60 days of completion of work. Contractor's final retention payment shall not be released until all manufacturers' system certifications have been received and reviewed by the Architects Technology Consultant.

C. Correct all failures or improper conditions.

D. Demonstrate to the Owner the proper care and maintenance of all new items.

1.15 GUARANTEE

A. Unless stated otherwise in Division 1:
   1. The Contractor and his surety shall guarantee in writing for a minimum period of one (1) year from the date of final acceptance that all materials, equipment, and labor furnished by Contractor are free from defects.
      a. Refer to cable system warranty for additional requirements.
   2. The Contractor shall further guarantee that if any piece of material or equipment is found to be defective within the guarantee period because of faulty manufacture or faulty installation, in the opinion of the Owner, Contractor shall replace and install and test such material or equipment without any further expense to the Owner.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 27 01 00

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

B. This section is inclusive to all Division 27 sections.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for the structured cabling system and campus inter-building distribution systems. It includes Contractor qualifications, terminations, and testing parameters. Reference individual sections for further expansion of these requirements.

B. Permits, Inspections, Codes and Regulatory References
1. General: Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Technology Consultant.
2. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable to electronic and electrical installations.
3. The following industry standards are the basis for the structured cabling system described in this document:
   a. TIA-568.1-E Commercial Building Telecommunications Cabling Standard
   b. TIA-568.2-E Balanced Twisted Pair Cabling Components Standard
   c. TIA-568.3-E Optical Fiber Cabling Components Standard
   d. TIA-568.4-E Broadband Coaxial Cabling and Components Standard
   e. TIA-569-E Commercial Building Standard for Telecommunications Pathways
   f. TIA-606-D Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
   g. TIA-607-E Telecommunications Bonding and Grounding (Earthing) for Customer Premises
   h. NFPA National Fire Protection Association
   i. NFPA 70 National Electric Code (NEC)
   j. ISO/IEC International Organization of Standards/International Electrotechnical Commission
   k. ISO 11801-1 Generic Cabling Requirements for Twisted Pair and Optical Fiber Cables

C. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

D. This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

1.3 ABBREVIATIONS AND DEFINITIONS

A. General: In addition to abbreviations defined in Division 1, utilize the following abbreviations and definitions for discernment with the Drawings and Specifications.

B. Abbreviations:
1. ANSI American National Standards Institute

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2. ASA American Standards Association
3. ASTM American Society of Testing Materials
4. AVC Audiovisual Contractor
5. BICSI Building Industry Consulting Service International
6. EC Electrical Contractor
7. ETL Electrical Testing Laboratories, Inc.
8. GC General Contractor
9. ICEA International Cable Engineers Association
10. ICIA International Communications Industries Association
11. IEEE Institute of Electrical and Electronics Engineers
12. NEC National Electric Code
13. NEMA National Electrical Manufacturers Association
14. NFPA National Fire Protection Association
15. NIC Not In Contract
16. NRTL Nationally Recognized Testing Laboratory
17. O Owner
18. OEM Original Equipment Manufacturers
19. OSHA Occupational Safety and Health Administration
20. OSP Outside Plant
21. SCC Structured Cable Contractor
22. TC Technology Consultant
23. TIA Telecommunications Industry Association
24. UL Underwriter's Laboratories, Inc.

C. Definitions:
1. ACCEPTED means as accepted by the Technology Consultant or his representative.
2. APPROVED means as approved by the Technology Consultant or his representative.
3. ARCHITECT means Fishbeck or their designated representative.
4. AS DIRECTED means as directed by the Technology Consultant or his representative.
5. AS REQUIRED means as required by some other part of the contract documents which may include reference specifications or manufacturer’s recommended practice.
6. AS SHOWN means as shown on the drawings, shop drawings, or other graphical elements of the contract documents.
7. BIDDER is used to indicate that entity generating the bid response.
8. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.
9. CONDUIT means the inclusion of all fittings, hangers, supports, sleeves, etc.
10. CONTRACTOR is used to indicate the successful Bidder to whom the Owner has awarded the contract.
11. EQUAL means equivalent as approved by the Technology Consultant or his representative.
12. FURNISH means to indicate the responsibility to ship or deliver the item to the job site, freight prepaid, for receipt, staging, and installation by others.
13. INSTALL means to join, unite, fasten, link, attach, setup or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular work referred to. It is also used to indicate the responsibility of receiving the item at the job site, providing adequate storage, unpacking, or uncrating the item, physically securing the item, or otherwise making ready the item for its intended use by following the instructions and approved methods of the manufacturer and those contained herein.
14. OWNER or CLIENT means Van Buren Township or their designated representative.
15. OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) shall refer to equipment that shall be furnished by the Owner for installation by the Contractor. The Contractor shall be responsible for installing and integrating this equipment as detailed herein.
16. PROVIDE means to furnish, install, place, erect, connect, test, and turn over to Owner complete and ready for the regular operation, the particular work referred to.
17. PROVIDED BY OTHERS shall refer to material and work which is related to this contract but has been provided by parties other than the Contractor.
18. SPECIFICATION is defined as the body of documentation provided to the Contractor with the Request for Quotation, as well as all addenda to said documentation. Throughout this document, words such as “herein” refer to the entire Specification, and not just this written document. The Specification includes, but is not limited to, this written specification document, all drawings, as listed

in the List of Drawings, cable terminations and labeling schedule, additions and/or modifications as detailed in written addenda, additions and/or modifications as detailed in drawing additions or reissues.

19. TECHNOLOGY CONSULTANT refers to NV5 Technology and Acoustics, 1501 Reedsdale Street, Suite 300, Pittsburgh, PA 15223.
20. The term SHALL is mandatory; the term WILL is informative; and the term SHOULD is advisory.
21. WIRING means the inclusion of all raceways, fittings, conductors, connectors, patch panels, labeling, junction and outlet boxes, connections, testing, and all other items necessary and/or required in connection with such work.

D. For the purpose of Division 27, in the event of conflict with an abbreviation or definition in Division 1 and in Division 27, the Division 27 abbreviation or definition shall prevail.

1.4 PERMITS, CODES, STANDARDS, AND INSPECTIONS

A. Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Technology Consultant.

B. The installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable to electronic and electrical installations.

C. Unless stated in Division 1, the installation shall be in compliance with the requirements of the latest revisions of:

1. All approved published instructions set forth by equipment manufacturers.
2. All local codes and ordinances in effect and having jurisdiction.
3. Americans with Disabilities Act (ADA)
4. All requirements of electric and telephone utility companies
5. BICSI Telecommunications Distribution Methods Manual (latest edition)
6. International Building Code (IBC)
7. Institute of Electrical and Electronic Engineers (IEEE)
8. National Board of Fire Underwriter's (NBFU)
9. National Electric Code (NEC)
10. National Electrical Manufacturer's Association (NEMA)
11. National Electric Safety Code (NESC)
12. Occupational Safety and Health Act (OSHA)
13. Telecommunications Industry Association (TIA)

D. Submit certificates issued by approved authorized agencies to indicate conformance of all work with the above requirements, as well as any additional certificates as may be required for the performance of this contract work.

E. Should any change in drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify the Technology Consultant prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instructions of the Architect and the Technology Consultant at no additional cost to the Owner.

1.5 CONTRACTOR QUALIFICATIONS

A. All bidders shall demonstrate their qualifications by providing the following documents:

1. A list of the LAST five (5) Structured Cabling systems that were installed by the bidder:
2. The listing shall include only systems that included the installation of fiber optic cable and Category 5e or 6 twisted pair.
3. The listings shall be for the last five (5) projects that are completed and have been turned over to the Owner.

4. The listing shall include a brief description of the project, size of the system, products used, Owner's name, phone number, address, and representative, date started, and date of completion

B. The bidder shall furnish a list of all test equipment to be used in the installation and testing of the fiber optics, multi pair copper distribution and UTP cable.

C. Performance testing of CAT6A cable shall be completed using a Fluke DSX2-5000 Cable Analyzer. Performance testing of fiber optic cable shall be completed using an OTDR. Proof of valid and current test equipment calibration and firmware must be provided to Owner 30 days prior to testing.

D. The bidder shall furnish a listing of the names of full-time employees that shall work on the project and list their training and certification in the installations and testing of structured cabling. At all times through the duration of the project a minimum of 25% of the on-site cabling personnel, including the project lead, shall be BICSI Certified Installers (ITS Installer 1). Submit the BICSI Installer Certificates with bid.

E. The bidder shall have a Registered Communication Distribution Designer (RCDD) with five (5) years of experience on staff. Submit the RCDD Certificate and project information with bid.

F. All of the above documents shall be submitted along with the Bid Form, by the Bid due date.

G. The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data and voice network systems. The Contractor shall at a minimum possess the following qualifications:
   1. Those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
   2. Personnel trained and certified in the design of the Ortronics Cabling System. Submit the Cabling System Design Certificates with bid.
   3. Personnel trained and certified to install the Ortronics Cabling System. Submit the Cabling System Installation Certificates with bid.

H. Personnel must be knowledgeable in local, state, and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall apply.

I. The Contractor shall have been in the business of installing structured cabling systems for a minimum of five (5) years.

J. The Contractor must possess and maintain current liability insurance certificates.

1.6 WARRANTIES

A. Provide complete written warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.

B. Warranty and Certification of the Cabling systems and connectors:

C. The Contractor shall provide a minimum 25-year performance and product warranty that installation, cable, connectors and connecting hardware shall be free from defects in material, workmanship, and fabrication. Submit detailed warranty documentation with close out documentation.

D. The system shall be certified by the cable/connector manufacturer and warranted for the specified performance for minimum of 25-year. The Contractor shall conform to the manufacturer's certification including submittals of all required documentation to the manufacturer.

E. The Contractor shall obtain, from the manufacturer, a Registration Document and Certificate for the specific installation issued in the Owner's name. Upon receipt of the Registration Document and Certificate, the Contractor shall forward a copy to the Technology Consultant and deliver the original to the Owner.

F. Any material, equipment, or appurtenance whose operation or performance does not comply with the requirements of the Contract or any equipment which is damaged prior to acceptance shall be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

1.7 SUBMITTALS

A. The Contractor shall provide product submittals for all system components. These components shall include all cable, termination devices, splice connectors, patch panels, associated racks and enclosures, patch cords, and labeling devices. The selected Contractor shall allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant.

B. Where multiple products are shown on one cut sheet, circle product to be used.

1.8 PROJECT DRAWINGS AND SPECIFICATIONS

A. The Contractor shall carefully examine the Drawings and Specifications of all trades and report discrepancies to the Technology Consultant in writing to obtain corrective action. No departures from the Contract Documents shall be made without prior written approval from the Technology Consultant.

B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Technology Consultant. The Architects' interpretation is final and binding.

C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.

D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Technology Consultant.

E. If there is a conflict between contract documents, the document highest in precedence shall control. The precedence shall be: first; permits from agencies as required by law, second; special provisions, third; specifications, fourth; drawings, fifth; reference specifications and sixth; vendor submittals.

1.9 COOPERATION AND COORDINATION WITH OTHER TRADES

A. The Structured Cabling Contractor shall be responsible for all cross connecting and coordination with vendors and other trades to provide a complete operational system.

1.10 PRODUCT LISTING

A. When two or more items of the same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, conduit, fittings, sheet metal, solder, fasteners, and similar items, except as otherwise indicated.

B. Provide products that are compatible within systems and other connected items.

C. All powered equipment shall be UL listed and follow approval criteria defined by the local authority having jurisdiction.

1.11 RECORD DRAWINGS

A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant and Owner a complete set of documents that clearly represent all contract work "as-built." This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation.

B. As part of the completed "As-Built" document package the Contractor shall deliver a final cable plant matrix (in spreadsheet format) of CAT6A outlets and floor plan with reference numbers. Final "As-Built" drawings shall be delivered in AutoCAD format.

1.12 MAINTENANCE MANUALS

A. Prepare maintenance manuals (Record Document) in accordance with the following information for equipment items:
   1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
   2. Manufacturer's data of each piece of equipment.

1.13 GENERAL WARRANTIES

A. Provide complete warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.

B. Any material, equipment, or appurtenance whose operation or performance does not comply with the requirements of the Contract Documents, or which are damaged prior to acceptance shall be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturers that are suitable for use in a unified system.

B. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.

C. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.

D. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size, and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage, and handling.

3.2 INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of systems, materials, and equipment.

B. Coordinate systems, equipment, and materials installation with other building components.

C. Verify all dimensions by field measurements.

D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for cabling installations.

E. Sequence, coordinate, and integrate installations of cabling materials and equipment for efficient flow of the Work.

F. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components.

G. Coordinate the cutting and patching of building components to accommodate installation of cabling equipment and materials.

H. Coordinate the installation of all materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.

I. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

J. Plywood on MDF/IDF walls shall be void-free fire-resistant grade AC grade or better with a minimum thickness of 0.75 inches with two coats of fire-resistant paint on all useable walls. Use flush hardware and supports to mount plywood. Ensure that the strength and placement of the hardware are sufficient to handle the total anticipated load and mounting of cabling components.

K. Ensure that the fire rating of all walls and floors is maintained. Plywood backboard sheets shall have the fire-rated stamp left visible for inspection.

3.3 CONDUIT AND RACEWAY

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A. Actual locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site.

B. Provide a pull box or pull point immediately before and after any conduit or raceway section containing two ninety-degree bends, or any single run exceeding one hundred feet in length. Pull box openings must face in the direction of approach and must have a minimum 8 inches in front of and to all sides of the opening. Pull boxes shall not be used in place of a bend. Conduits must always exit the pull box from the opposite side it entered (no change of direction inside the pull box shall be accepted).

C. Network outlet back boxes shall have dedicated, direct-run conduits sized as indicated on typical network conduit risers, unless noted otherwise. Daisy chaining outlet boxes shall not be accepted without prior approval from the technology consultant.

D. Conduits to floor boxes and poke thrus shall be direct runs and sized as indicated on typical network conduit risers, unless noted otherwise. Daisy chaining outlet boxes shall not be accepted without prior approval from the technology consultant.

E. Carefully investigate the structural, electrical/electronic, and finished conditions of work accordingly.

3.4 CABLE PROTECTION

A. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

3.5 FIRESTOPPING

A. General
   1. Provide through penetration fire stop systems to prevent the spread of fire through openings made in fire-rated walls or floors to accommodate penetrating items such as conduit, cables, and cable tray. Fire stop shall restore floor and wall to the original fire rated integrity and shall be waterproof. The fire stop systems and products shall have been tested in accordance with the procedures of U.L. and material shall be U.L. classified as materials for use in through-penetration fire stops.
   2. The fire stop system shall comply with the NEC and with NFPA 101-Life Safety Code (latest edition) and shall be made available for inspection by the local inspection authorities prior to cable system acceptance. The Contractor shall be responsible for verifying the fire rating of all walls and floors having cabling penetrations. Coordinate sealant installation with work of other trades and with the general Contractor on site.
   3. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) or shall be approved by a qualified Professional Engineer (PE), licensed in the state of Michigan.
   4. A drawing showing the proposed fire stop system shall be provided to the Owner and Technology Consultant prior to installing the fire stop system(s).

3.6 GROUNDING AND BONDING

A. Ground communications systems and equipment in accordance with the TIA-607-E Grounding Standard and NEC requirements except where the Drawings or Specifications exceed NEC requirements. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, paging equipment, CATV equipment etc. entering or residing in technology spaces shall be grounded to the respective ground system using a minimum #6 AWG solid copper bonding conductor and compression connectors. All wires used for technology grounding purposes shall be identified with green insulated wires. All cables and bus bars shall be identified and labeled in accordance with the Technology Identification requirements.

3.7 TESTING

A. Contractor, at his own expense, shall make any tests directed by an inspection authority or by the Technology Consultant and shall provide all equipment, instruments, and materials to make such tests.

B. Upon completion of work, all component parts, both singularly and as a whole, shall be set, calibrated, adjusted, and left in satisfactory operation condition to suit load conditions, by means of instruments furnished by the Contractor.

C. Notify the Owner and Technology Consultant seven (7) days prior to the testing dates. Upon completion of a test, a statement of certification shall be forwarded to the Technology Consultant for his approval.

END OF SECTION 27 05 00

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

B. Drawings and general provisions including Division 1, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Commercial building grounding and bonding requirements for telecommunication infrastructure.
   2. Requirements for bonding and communications cabling, equipment, pathways, spaces, and mounting equipment.
   3. Basic requirements for grounding for protection of life, equipment circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

B. Comply with the TIA-607-E, “Grounding and Bonding Requirements” and the NEC.

1.3 RELATED SECTIONS:

A. Section 01 33 00 – Submittal Procedures.

B. Section 26 05 26 – Grounding and Bonding for Electrical System.

C. Section 27 01 00 – Operation and Maintenance of Communications Systems

D. Section 27 05 29 - Hangers and Supports for Communications Systems

1.4 REFERENCES

A. ANSI/NFPA-70, 2020 National Electrical Code (NEC)

B. ANSI/IEEE Std. 1100-2005, Recommended Practice for Powering and Grounding Electronic Equipment

C. ANSI/IEEE Std. C2, 2007 National Electrical Safety Code (NESC)

D. TIA-607-E Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises

E. ANSI/TIA-606-D Administration Standard for Telecommunications Infrastructure

F. NECA/BICSI 607-2014, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

G. OSHA Standards and Regulations - all applicable

H. Local Codes and Standards - all applicable

I. Anywhere low-voltage cabling Standards conflict with electrical or safety Codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either. Knowledge and execution of applicable codes is the sole responsibility of the Contractor. Any code violations committed at the time of installation shall be remedied at the Contractor's expense. Contractor is responsible to bring any perceived conflicts between project documents and referenced Standards or Codes to the attention of the Architect and Technology Consultant for resolution.

1.5 SYSTEM DESCRIPTION

A. Provide a communications bonding and grounding system as described in this document and project drawings and in compliance with the above cited Codes, Standards and Agencies.

B. Comply with the requirement of Code of Practice for Info-Communications Facilities in Buildings.

C. Comply with the requirement for Section 26 05 26 - Grounding and Bonding for Electrical System.

D. Bond the following items within the telecommunications grounding system.
   1. All communications system active equipment.
   2. All PDU and surge protection equipment.
   3. Raised floor systems.
   4. Underfloor grounding grids (a.k.a. "supplemental bonding grids" or SBGs) for computer or telecommunications rooms.
   5. Metallic raceway systems, including metallic cable trays.
   6. Communications equipment enclosures (cabinets) or cross-connect frames.
   7. Broadband passive devices.
   8. Metallic splice cases.
   9. Metallic cable screens, armor, or shields.
   10. All metal cable conduit.
   11. Electrical service panels in entrance facilities, telecommunications, and equipment rooms.
   12. Wall and rack mounted grounding busbars.
   13. Exposed building steel that is within 6 feet of equipment racking systems.
   14. Building steel extending to earth in outside-plant.
   15. All related bonding accessories.

1.6 SUBMITTALS

A. Submit the following:
   1. The Contractor shall provide product submittals for all system components as defined in Part 2 of this specification section and all associated project specifications. These components shall include all grounding and bonding products required for a complete grounding and bonding system.
   2. Where multiple products are shown on one cut sheet, circle product to be used.
   3. Shop drawings showing construction details and locations of components, and description and routing of interconnecting cabling.
   4. Field-testing organization certificates, signed by the Contractor, certifying that the organization performing the tests complies with the requirements specified in Quality Assurance below.

B. The selected Contractor shall allow sufficient time in project scheduling for client and review by the Architect and Technology Consultant.

1.7 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings of types and rating required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3-years.

B. Installer: Qualified with at least 3-years of successful installation experience on projects with technology ground work similar to that required for this project.

C. Listing and labeling: Provide products specified in this Section that are listed and labeled. The terms “listed” and “labeled” shall be defined as they are in the National Electric Code, Article 100.

D. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

E. Field-testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM699, that it has the experience and capability to satisfactorily conduct the testing indicated.

F. Component Standard: Components and installation shall comply with NFPA 70, “National Electric Code” (NEC).

G. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical and electronic grounding.

H. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical and electronic grounding.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. B-Line Systems, Inc.
2. Burndy Corp.
3. Crouse-Hinds Co.
4. Electrical Components Division; Gould Inc.
5. General Electric Supply Co.
6. Ideal Industries, Inc.
7. Panduit.
8. Thomas & Betts Corp.

2.2 PRODUCTS

A. Supply types indicated and of sizes and rating to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 CONDUCTOR MATERIALS

A. Copper with minimum 98% conductivity.

2.4 WIRE AND CABLE CONDUCTORS

A. Coordinate with Division 26 Sections.

B. Equipment Grounding Conductor: Green insulated.

C. Grounding Electrode Conductor: Stranded cable.

D. Bare Copper Conductors:
   1. Conform to the following:
      a. Solid Conductors: ASTM B-3.
      b. Assembly of Stranded Conductors: ASTM B-8.
      c. Tinned Conductors: ASTM B-33.

2.5 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section. All bus bars shall be two-hole lug type.

B. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch-thick and 2 inches wide, except as indicated.

C. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire, 3/4” wide, 9-1/2” long; 48.250cm. Protect braid with copper bolt hole ends with holes sized for 3/8” diameter bolts.

2.6 CONNECTOR PRODUCTS

A. Listed and labeled as grounding connectors for materials used and approved by a nationally recognized testing laboratory.

B. Pressure Connectors:

C. High-conductivity-plated units.
   1. All lugs shall be two-hole type.

D. Bolted Clamps: Heavy-duty units listed for the application.

2.7 GROUNDING ELECTRODES

A. For technology systems, provide a #2 AWG minimum insulated stranded copper conductor from the grounding electrode system to each telecommunication room, terminal cabinet, and central location.

B. Bonding Plates, Connectors, Terminals, and Clamps: Provide electrical bonding plates, connectors, terminals, lugs, and clamps as recommended by manufacturers for indicated applications.

C. Connectors, Terminals, and Clamps shall be compression type.

D. Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps, as recommended accessories by manufacturers.

2.8 PIPE CLAMPS

A. Used to ground copper code conductor to water pipe or copper tubing.

B. Cast from high strength, electrolytic bronze to provide reliable grounding connections.

C. Plated steel screws provide high strength and inhibit corrosion.

D. Accommodates a wide range of pipe, tube, rod, and conductor sizes - minimizes inventory.

E. cULus 467 Listed for grounding and bonding with AWG conductor.

F. Reference bronze grounding pipe clamps are as follows:
   1. Panduit #GPC2-1-Q for pipe range 1/2 – 1" and conductor size range #10 SOL - #2 STR.
   2. Panduit #GPC2-2-L for pipe range 1 1/4 – 2 and conductor size range #10 SOL - #2 STR.
   3. Panduit #GPC2-4-X for pipe range 2 1/2 – 4 and conductor size range #10 SOL - #2 STR.
   4. Panduit #GPC2-6-X for pipe range 4 1/2 – 6 and conductor size range #10 SOL - #2 STR.

2.9 COMPRESSION-TYPE ALUMINUM-TO-COPPER REDUCING SPLICE

A. Dual rated for use with aluminum or copper conductors.

B. Factory pre-filled with joint compound and sealed with easy pull-out end plug to inhibit corrosion.

C. Color-coded end plug and Panduit die index numbers marked on barrel for proper crimp die selection.

D. Tin-plated to inhibit corrosion.

E. For use up to 35 KV and temperature rated 90°C when crimped with Panduit crimping tools and dies.

F. Reference compression type aluminum to copper reducing splices are:
   1. Panduit #SAR2-4-X for bonding aluminum conductor size #2 AWG to Aluminum or copper conductor size #4 AWG.

2.10 COPPER AND ALUMINUM ONE-HOLE GROUNDING LAY-IN LUG FOR BONDING LADDER RACK

A. Used for quick installation of a continuous grounding conductor

B. cULus 467 Listed for grounding and bonding, copper lugs. UL Listed for direct burial in earth or concrete

C. cULus Listed for use up to 600 V and temperature rated 90°C

D. Reference copper and aluminum one-hole grounding lay-in lug for bonding ladder racks are:
   1. Panduit #LICC4-22-C copper body, 0.22-inch stud hole, conductor size range AWG #14 SOL - #4 STR.
   2. Panduit #LICC4-22TP-C tin plated copper body, 0.22-inch stud hole, conductor size range AWG #14 SOL - #4 STR.
   3. Panduit #LIAC4-22-C tin plated aluminum body, 0.22-inch stud hole, conductor size range AWG #14 SOL - #4 STR.
   4. Panduit #LIAS250-56-Q tin plated aluminum body, 0.33-inch stud hole, conductor size range AWG #6 SOL – 250 KCMil STR.

2.11 COMMUNICATIONS GROUNDING RODS

A. Material: Copper-clad steel.

B. Size: 3/4-inch by 8 feet long.

C. Standards: Meet requirements of ANSI®/UL 467-1984, CSA, and ANSI/NEMA GR-1.

D. Approved manufacturers:
   1. Erico

2.12 ELECTROLYTIC GROUND RODS

A. Where standard ground rods do not have acceptable levels of conductivity (typically greater than 5 ohms resistance) to earth due to local soil conditions, electrolytic systems may be considered.

B. Such systems shall meet the following:
   1. Be comprised of a hollow stainless steel or copper tube 10 feet or longer and filled with a mixture of hygroscopic electrolytic salts.
   2. Function as an active grounding system by absorbing moisture out of the air and constantly leaching and electrolytic solution into the surrounding soil to maintain high conductivity.
   3. Rod shall be encased in a conductive, non-corrosive carbon based back fill material.
   4. Provide low resistance to ground.
   5. Provide season to season stability.
   6. Be maintenance-free for 30 years.
   7. Contain no hazardous materials or chemicals.

2.13 TELECOMMUNICATIONS BONDING BACKBONE (TBB) GROUNDING CONDUCTORS

A. To be bare or insulated copper, of minimum conductor size #6 AWG and sized at 2 KCMil per linear foot up to a maximum size of 750 KCMil.

B. Where un-insulated, to be identified with green tape at termination location.

C. Labeled in accordance with recommendations set forth in ANSI/TIA-606-D Administration Standard for Telecommunications Infrastructure.

D. Approved manufacturers:
   1. General Cable
   2. Southwire

2.14 TWO-HOLE, LONG-BARREL COPPER COMPRESSION LUGS FOR GROUNDING CONDUCTORS

A. Meets TIA-607-E requirements for network systems grounding applications.

B. Tested by Telcordia - meets NEBS Level 3 with AWG conductor.

C. UL Listed and CSA Certified with AWG conductor for use up to 35 KV** and temperature rated 90°C when crimped with Panduit crimping tools and dies.

D. Color-coded barrels marked with Panduit die index numbers for proper crimp die selection.

E. Have long barrel to maximize number of crimps and provides premium wire pull-out strength and electrical performance.

F. Have "inspection window" over tongue to visually assure full conductor insertion.

G. Be tin-plated to inhibit corrosion.

H. Available with NEMA and BICSI hole-sizes and spacing.

I. Reference two-hole, long-barrel copper compression lugs for grounding conductors are:
   1. Panduit #LCC-W series

2.15 CODE/FLEX CONDUCTOR H-TAPS

A. Used as a splice, or to tap smaller (pigtail) conductors into larger continuous conductors.

B. Each HTAP terminates a wide range of conductor sizes and combinations of code and flex conductors Class G, H, I and Locomotive to suit a variety of applications.

C. Slotted design allows quick and easy assembly of conductor to HTAP using three Panduit 94V-0 cable ties.

D. Tap grooves are separated from one another, allowing them to function independently so HTAP can be used with single or multiple conductors, providing maximum design and installation flexibility.

E. Color coded and marked with Panduit die index numbers for proper crimp die selection.

F. UL Listed and CSA Certified, with wide size range of conductor sizes and rated for applications up to 600 V when crimped with Panduit tools and dies.

G. Tin plated to inhibit corrosion.

H. Available with an assortment of clear covers with integrated label fields.

I. Reference parts for HTAPs and clear covers are:
   1. Panduit #HTCT series - must be selected according to AWG size of run and tap conductors.
   2. Panduit #CLRCVR series clear covers for HTAPs - must be selected according to HTAP being covered.

2.16 CODE CONDUCTOR, THIN WALL, TIN-PLATED C-TAP (SPLICE)

A. For copper-to-copper splicing or pigtail tap splicing.

B. Wide wire range-taking capability minimizes inventory requirements.

C. Color-coded for proper crimp die selection.

D. Ribbed design provides high strength.

E. Made from high conductivity wrought copper.

F. Tin-plated to inhibit corrosion and oxidation.

G. UL Listed and CSA Certified with AWG conductor to 600 V and temperature rated to 90°C when crimped with Panduit crimping tools and dies.

H. Reference parts for C-TAPs are:
   1. Panduit #CTAPF series - must be selected according to AWG size of conductors being spliced.

2.17 IEEE UNIVERSAL BEAM GROUNDING CLAMP

A. For bonding structural steel (ex: I-beams) into bonding network.

B. Universal, fits on a wide range of standard (angled) and wide flange (parallel) structural steel beams.

C. Provide a mounting pad suitable for a two-hole compression lug.

D. Installs quickly and easily with standard 1/4" key hex wrench tooling.

E. UL 467 Listed and CSA 22.2 Certified for grounding and bonding suitable for direct burial in earth or concrete.

F. Comply with vibration tests per MIL-STD-202G (METHOD 201A).

G. Reference parts for beam grounding clamps are:
   1. Panduit #GUBC500-6 for copper conductor sizes ranging from #6 AWG to 500 KCMil and flange thickness from .25" to .675". Stud size is 1/2" with hole spacing for two-hole lug being 1.75" and thread size from 1/2 to 13.

2.18 SPLIT BOLT FOR BONDING CABLE TRAYS

A. Made from high strength copper alloy to resist corrosion and provide premium electrical and mechanical performance.

B. Wire range-taking capability minimizes inventory requirements.

C. Nut hex provides correct fit with socket, box, or open-end wrenches resulting in proper torquing of electrical connection.

D. Pressure bar provides secure connection on a full range of conductor combinations used with each connector assuring premium wire pull-out strength.

E. UL Listed and CSA Certified with AWG conductor for use up to 600 V and temperature rated 90°C.

F. Available in tin-plated version for bonding to galvanized wire baskets and Flex Tray.

G. Reference parts are:
   1. Panduit #SBC3-C split lug for #8 AWG to #4 AWG code conductors.
   2. Panduit #SBCT3-C split lug for #8 AWG to #4 AWG code conductors - tinned for use with galvanized basket tray delivery systems.

2.19 AUXILIARY CABLE BRACKETS (CONDUCTOR PATHWAY)

A. Used for mounting telecommunications bonding conductors outside of cable tray.

B. Maintain minimum 2" separation between bonding conductors and all other types of cabling per TIA-607-E.

C. Bonds ladder rack, wire basket sections together without drilling holes or applying other split-bolt clamps.

D. Supports grounding conductors in the telecommunications room, allows separation of grounding conductors from other cables.

E. Holds up to four conductors in sizes up to 750 KCMil.

F. Bonds to all 1" and 2" ladder rack rails.

G. Paint piercing teeth provide electrical continuity between cable pathway sections while minimizing debris.

H. Front and back mounting screw options allow easy installation and visual inspection.

I. Can be mounted above or below the cable pathway system for flexibility.

J. Meet requirements TIA-607-E.

K. Have available bonding jumper kits to bond sections of basket tray or ladder rack.

L. Reference parts are:
   1. Panduit #GACB-2 auxiliary cable bracket; 1.63" (41.4mm) width, 3.95" (100.3mm) height, 5.22" (132.6mm) depth; provided with one mounting screw.
   2. Panduit #GACBJ612U auxiliary cable bracket jumper for bonding pathway sections; #6 AWG (16mm²); 12.0" (305mm) length; factory terminated on both ends with straight, two-hole, long barrel compression lugs; provided with .16 oz. (5cc) of antioxidant and four mounting screws.

2.20 WALL-MOUNT BUSBARS (TGB AND TMGB AND LABELING)

A. Meet BICSI and TIA-607-E requirements for network systems grounding applications.

B. Employ BICSI hole spacing to fit LCC-W series 2-hole lugs.

C. Be made of high conductivity copper and tin-plated to inhibit corrosion.

D. Come pre-assembled with brackets and insulators attached for quick installation.

E. Use Panduit component labels, sold separately, to identify busbars to meet TIA-606-D.

F. Reference parts are:
   1. Panduit #GB2B0306TPI-1 telecommunications grounding busbar (TGB) with 6 number of mounting positions with 1/4" stud hole and with 5/8" hole spacing, and 3 number of positions with 3/8" stud hole with 1" hole spacing.
   2. Panduit GB2B0312TPI-1 telecommunications grounding busbar (TGB) with12 number of mounting positions with 1/4" stud hole with 5/8" hole spacing, and 3 number of positions with 3/8" stud hole with 1" hole spacing.
   3. Panduit # GB4B0624TPI-1 telecommunications main grounding busbar (TMGB) with 24 number of mounting positions with 1/4" stud hole with 5/8" hole spacing, and 6 number of positions with 3/8" stud hole with 1" hole spacing.
   4. Panduit # GB4B1028TPI-1 telecommunications main grounding busbar (TMGB) with 28 number of mounting positions with 1/4" stud hole with 5/8" hole spacing, and 10 number of positions with 3/8" stud hole with 1" hole spacing.
   5. Panduit #LTYK busbar label kit includes one printed tag and on flame retardant cable tie.

2.21 VERTICAL GROUNDING STRIP BUSBARS FOR NEW INSTALL RACKS AND CABINETS

A. Provides clean bond to any rack mounted equipment regardless of whether or not equipment has an integrated grounding terminal.

B. Bonds up to 45 RU per rack.

C. Comes in ECA Universal mounting hole pattern.

D. Complies with US and International grounding requirements.

E. Comes in threaded rail and cage nut versions.

F. Reference parts are:

1. Panduit #RGS134-1Y grounding strip for use with threaded rails; 78.65" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
2. Panduit #RGS134B-1 grounding strip for use with cage nut rails; 78.70" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.
3. Panduit #RGS13442-1 grounding strip for use with threaded rails; 73.70" (1.9m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three each, #12-24 x1/2” and M6 x12mm thread-forming screws.
4. Panduit #RGS13448-1 grounding strip for use with threaded rails; 83.90" (2.1m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
5. Panduit #RGS13451-1 grounding strip for use with threaded rails; 89.15" (2.3m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
6. Panduit #RGS13452-1 grounding strip for use with threaded rails; 90.90" (2.3m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
7. Panduit #RGS134B42-1 grounding strip for use with cage nut rails; 73.40" (1.9m) length; .67" (17mm) width; .03" (.76mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.
8. Panduit #RGS134B48-1 grounding strip for use with cage nut rails; 83.90" (2.1m) length; .67" (17mm) width; .03" (.76mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.

2.22 RACK BONDING CONDUCTOR KITS (RBC)

A. Bonds the rack or cabinet to the telecommunications grounding busbar (TGB or TMGB).

B. Jumper kits available with both ends factory terminated to provide a bolt-on solution.

C. Jumper kits available with one end factory terminated to attach to the rack or cabinet; free end accommodates unique length requirements.

D. Engineered to comply with US and international grounding requirements.

E. Reference parts are:
1. Panduit #GJ672UH terminated on both ends for smaller telecommunications rooms where racks have individual connections directly to the TMB. One 72" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAWH-L and the other end with LCC6-14JAW-L. Comes in lengths 72", 96", 120", 144", 168", 192:", 216", 240", 264", and 288". For other lengths substitute "72" in part number with desired length.
2. Panduit #GJS6120U terminated on one end for larger telecommunications rooms where racks are individually bonded to underfloor or overhead bonding backbone with an HTAP connection. One 120" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAW-L. For 180" length substitute "120" in part number with "180"
3. Panduit # HDW1/4-A-KT stainless steel mounting hardware for busbar; two 1/4-20 hex bolts, two 1/4-20 hex nuts, four 1/4 flat washers and two 1/4 Belleville compression washers. Mounting hardware for rack or cabinet; two #10-32 thread-forming screws and two M5 thread-forming screws.
4. Panduit #HDW3/8-A-KT stainless steel mounting hardware for busbar; two 3/8-16 hex bolts, two 3/8-16 hex nuts, four 3/8 flat washers and two 3/8 Belleville compression washers. Mounting hardware for rack or cabinet; two #10-32 thread-forming screws and two M5 thread-forming screws.

2.23 ELECTROSTATIC DISCHARGE (ESD) PORT KITS AND WRIST STRAP

A. For dissipating electro-static buildup prior to maintenance work on network equipment.

B. Accommodate standard ESD wrist strap 4mm plug.

C. Wrist strap provides rapid and continuous drain of electrostatic charge between a person and the surface to which the wrist strap is bonded, thus preventing damaging static discharge into equipment.

D. Can be mounted to front or back of rack or cabinet for convenient access.

E. Bent 45° to act as a hook to hold wrist strap when not in use.

F. Two-hole configuration provides anti-rotation and prevents loss of bond.

G. Barrel permanently marked with the protective earth (ground) symbol.

H. Engineered to comply with US and International grounding requirements.

I. Versions for threaded racks rails or cabinet cage nuts.

J. Reference parts are:
   1. Panduit #RGESD2-1 for #12-24 or M6 rail fasteners: Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, and two each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
   2. Panduit #RGESD2B-1 for cage nut rail fasteners: Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, two cage nut bonding studs and two #12-24 bonding nuts.
   3. Panduit #RGESDWS adjustable fabric ESD wrist strap with 6' coil cord, banana plug, 1 megaohm resistor and 4mm snap.

2.24 EQUIPMENT JUMPER KITS (UNIT BONDING CONDUCTOR OR "UBC")

A. Used to ground large, chassis-style rack mounted equipment that have built-in grounding pads or terminals.

B. Bond network equipment to grounding strip or grounding busbar.

C. Jumper kit available with both ends factory terminated to provide a bolt-on solution.

D. Jumper kit available with one end factory terminated to attach to the grounding strip or grounding busbar; free end accommodates unique equipment terminations.

E. Use jumpers with 90° bent lug, on grounding strip side, for high density grounding requirements up to one ground point per RU.

F. Use jumpers with 45° bent lugs on grounding strip side, for improved cable management.

G. Engineered to comply with US and International grounding requirements.

H. Reference parts are:
   1. Panduit #GJS6 series #6 equipment jumper factory terminated on one end for switches, cabinets and 4 post racks. Exact part number depends on length.
   2. Panduit #RGE series factory terminated jumpers that are terminated on both ends. Exact part number depends on AWG size, length, and angle of two-hole lugs.

2.25 SURGE SUPPRESSOR JUMPER KIT

A. Bonds power or data line surge suppressor to grounding strip or grounding busbar.

B. Both ends factory terminated to provide a bolt-on solution.

C. Engineered to comply with US and International grounding requirements.

D. Reference parts are:
   1. Panduit #SSGK-1 #10 AWG (6mm²) jumper; 24" (.61m) length; factory terminated on both ends; one-hole lug on surge suppressor to two-hole lug on grounding strip/busbar side; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws.

2.26 ARMORED CABLE GROUNDING KIT

A. Provides a secure bond to the armor sheath on indoor and indoor/outdoor fiber optic cables at both cassette and enclosure ends.

B. Worm-gear design evenly distributes forces across the armor.

C. Made from steel and aluminum material is compatible with common armor for long term reliability.

D. Black insulating cover protects and hides the connection for an aesthetically pleasing work area.

E. Complies with industry requirements ensuring a high level of reliability and safety.

F. Reference parts are:
   1. Panduit #ACG24K #6 AWG (16mm2) jumper for armored cable diameter up to 0.84" (21.3mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover.
   2. Panduit #ACG24K-500 #6 AWG (16mm2) jumper for armored cable diameter 0.85" (21.3mm) to 1.03" (26.2mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover.
   3. Panduit #ACGK armored cable grounding kit. Contains one grounding terminal for #6 AWG grounding conductor, and one #10 mechanical clamp for cable diameters in 9/16" – 1 1/16" diameter range.

2.27 MISCELLANEOUS BONDING ACCESSORIES:

A. Anti-oxidation Paste (contact aid) For Copper to Copper and Copper to Steel Connections.

B. Anti-oxidation Paste (contact aid) For Aluminum Pad-to-Pad or Thread-to-Thread Aluminum Connections.

C. Green thread-forming bonding screws for bonding smaller equipment on threaded rack rails through the equipment mounting flange.

D. Green bonding cage nuts from bonding smaller equipment on cage nut rails through the equipment mounting flange.

E. Thread forming screws for bonding two-hole lugs to Rack Bonding Busbar (RBB) on threaded rack rails.

F. Green paint piercing grounding washers for assuring electrical continuity between painted parts of equipment racks as described in TIA-607-E Standard.

G. Bonding hardware kits (studs) for forming low-resistance bond between the rack or cabinet and painted rack mounted appliances and equipment.

H. Reference parts are:
   1. Panduit #CMP-300-1 contact aid (antioxidant paste) for copper-to-copper and copper-to-steel connections in 8 oz container. Operating temperature range -40°F (-40°C) to 350°F (177°C). Good for all voltages and suitable for grounding. Also, may be used for anti-seizing thread lubricant.
   2. Panduit #CMP-100-1 contact aid (antioxidant paste) for pad-to-pad or thread-to-thread aluminum connections made on aluminum conductor in 8 oz container. Operating temperature range -40°F (-40°C) to 400°F (204°C).
   3. Panduit #RGTBSG-C green thread-forming bonding screw, #12-24 x 1/2" for mounting smaller equipment and bonding to rack/cabinet racks through equipment mounting flange.
   4. Panduit #RGTBS1032G-C green thread-forming bonding screw, #10-32 x 1/2" for mounting smaller equipment and bonding to rack/cabinet racks through equipment mounting flange.
   5. Panduit #CNB4K green bonding cage nut, includes 4 #12-24 bonding cage nuts (.06 – .11 thick panel) and 4 #12-24 x 1/2" bonding screws with #2 Phillips/slotted combo hex head (use 5/16" or 8mm socket). Ideal for patch panel applications.
   6. Panduit #CNBK green bonding cage nut, includes 50 #12-24 bonding cage nuts (.06 – .11 thick panel) and 50 #12-24 x 1/2" bonding screws with #2 Phillips/slotted combo hex head (use 5/16" or 8mm socket).
   7. Panduit #RGW-100-1Y 100 paint piercing bonding washers for 3/8" (M8) stud size; .875" (22.2mm) O.D.; provided with .16 oz. (5cc) of antioxidant.
   8. Panduit #TRBSK bonding stud kit for threaded #12-24 rail fasteners; includes 25 bonding studs and 50 bonding nuts for bonding painted equipment and appliances to rack/cabinet rails and vertical busbars.
   9. Panduit #CGNBSK bonding stud kit for cage nut rail fasteners; includes 25 bonding studs and 50 bonding nuts for bonding painted equipment and appliances to rack/cabinet rails and vertical busbars.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
   1. This Specification document describes a generic enterprise communications bonding and grounding system for the construction of a complete and functioning grounding system. It is the responsibility of the installing Contractor to adapt these general guidelines and principles to the requirements of the actual environments where the systems are to be implemented.
   2. System shall provide equipment ground connections (bonds) from the premises entrance facility and outside-plant earthing system to each telecommunication room telecommunication ground busbar, through the racking systems to bond the network equipment.
   3. Entire grounding link from equipment to earth should be visually verifiable except where hidden by walls, conduit, or pathways.
   4. Installing Contractor shall label all elements of the communications bonding network according to guidelines defined in TIA-607-E and ANSI/TIA-606-D.
   5. It is the responsibility of the installer to be knowledgeable of all previously cited Standards and Codes and to bring to the attention of Architect and Technology Consultant any conflicts or discrepancies to achieve a fully functioning, standards-compliant earthing system.
   6. Contractors working around or adding to existing legacy systems shall bring to the attention of Architect and Technology Consultant previously installed network elements that may not comply with modern grounding requirements for possible remediation.

B. Telecommunications Bonding Backbone (TBB):
   1. Bonding and grounding conductors may be insulated or un-insulated and shall not decrease in size as the grounding path moves closer to earth.
   2. Connections (bonds) between the telecommunications grounding network and associated electrical panels shall be done by a qualified electrician in accordance with guidelines in TIA-607-E and applicable electrical codes.

3. Bonding Conductors should be continuous and routed in the shortest possible straight-line path, avoiding changes in elevation and sharp bends.
4. TBB conductors shall be protected from mechanical damage and built so as to minimize splicing. Where splicing is unavoidable, they shall be done using irreversible compression splices (C-TAPS) built to that purpose. See the "Materials" section of this document for appropriate compression splices.
5. TBB in multi-story buildings with multiple risers (multiple TBBs) shall employ a Backbone Bonding Conductor (BBC) or grounding equalizer (GE) between vertical grounding backbones at the top floor of the building and minimally at every third floor in between to the lowest floor level. The BBC shall be no smaller than the largest sized TBB.
6. Routing grounding conductors through ferrous metal conduit should be avoided, but if it is necessary due to building constraints, any grounding conductor running through ferrous conduit longer than 3 feet shall be bonded at the end using appropriately sized HTAP and Conduit grounding clamps as described TIA-607-E using appliances described for that purpose in the "Materials" section of this document.
7. Conductors used to bond TBB to conduit ends shall be of #6 AWG size or larger.
8. Conductor sizing shall be based upon project specification (drawings and notes) for that installation. These sizes are based on TBB length per TIA-607-E recommendations. Contractor shall bring to the attention of Architect and Technology Consultant anywhere TBB project specified sizing appears insufficient per the Table below:

Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
20-26 (67-84)	3/0
26-32 (85-105)	4/0
32-38 (106-125)	250 KCMil
38-46 (126-150)	300 KCMil
46-53 (151-175)	350 KCMil
53-76 (176-250)	500 KCMil
76-91 (251-300)	600 KCMil
Greater than 91 (301)	750 KCMil

C. Entrance Facilities and Telecommunications Main Grounding Busbar (TMGB):

1. TMGB shall be located in the entrance facility, near the electrical panel to which it will be bonded but installed to maintain clearances required by applicable electrical codes.
2. TMGB shall be sized according to the anticipated number of bonded connections needed.
3. TMGB shall have tinned surface to restrain oxidation and be cleaned and antioxidant paste applied prior to fastening conductors.
4. Connectors on TBB which attach to TMGB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
5. Building steel within six feet of the communications grounding system should be bonded into the system with appropriate hardware listed in "Materials" section of this document.
6. All cables containing a metallic shield or armor shall have that shield properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.

D. Telecommunications Rooms and Telecommunications Grounding Busbar (TGB):
1. Each telecommunications room shall have its own TGB to which equipment and dead steel (building steel and support structures) in that room are bonded.
2. The TGBs shall have a tinned surface to inhibit oxidation and be sized according to the anticipated number of bonded connections needed.
3. TGBs shall be sized according to the anticipated number of bonded connections needed.
4. TMGs shall have tinned surfaces to restrain oxidation and shall be cleaned and have an antioxidant paste applied to both bonding surfaces prior to fastening conductors.
5. Connectors on backbone and rack/cabinet bonding conductors which attach to TGB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
6. Building steel within six feet of the communications grounding system should be bonded into the system with beam clamps and other hardware appropriate to that purpose listed in "Materials" section of this document.
7. Racks and cabinets shall have individual Rack Bonding Conductors (RBC) bonding to the Telecommunications Equipment Bonding Conductor (TEBC) or underfloor "Supplemental Bonding Grid - DAISY CHAINING OR SERIAL CONNECTIONS OF ONE RACK OR CABINET TO ANOTHER SHALL NOT BE ACCEPTED.
8. Rack Bonding Conductors (RBC) or above rack row grounds (TEBC) shall be installed to maintain a minimum of 2" separation from all other types of cable - power or communications.
9. To maintain this segregation of cables some telecommunications rooms may lend themselves to the installation of Auxiliary Conductor Brackets for routing bonding conductors outside of, yet parallel to ladder rack or basket tray. See "Auxiliary Brackets" in "Materials" section of this document.
10. Bonding conductor support systems like auxiliary brackets shall be spaced no further apart than three-foot intervals.
11. All cables containing metallic shielding or armor shall be properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.

E. Bonding within Racks and Cabinets:
1. Racks and Cabinets shall be bonded into the communications bonding network with conductors of #6 AWG or larger.
2. Racks, cabinets, and similar enclosures shall not be attached serially (daisy-chained) but must have individual RBC into the grounding system.
3. Newly installed racks and cabinets shall have vertical grounding busbars installed along one rail to provide clean bonding landing point for all rack mount equipment. For part numbers of vertical busbars see "Materials" section of this document. Grounding busbars shall not be isolated from the rack or cabinet.
4. All painted components of racks/cabinets shall be assembled using serrated grounding washers and thread-forming screws to ensure electrical continuity between the different structural components of the rack/cabinet.
5. Larger equipment (chassis switches) with integral grounding terminals or pads shall be bonded to the vertical busbar with equipment grounding kits attached to those terminals and bonding them to the rack-mounted busbars. For kit part numbers see the "Materials" section of this document.

6. Anywhere two metallic surfaces are to be bonded, Contractor shall clean the contact areas of paint or oxidation using abrasive pads and apply film of anti-oxidation compound between surfaces prior to bonding.
7. All cable fittings shall be of two-hole (LCC series) compression-type. Mechanical screw-lugs on racking systems shall not be accepted and must be removed and replaced at Contractor's expense.
8. All screws used to affix compression lugs to rack-mounted vertical busbars shall be of the thread forming type made specifically for electrical bonding.
9. Smaller equipment (servers, TOR switches) not having integral grounding pads must be bonded to the rack through the equipment mounting flanges using green thread-forming grounding screws with serrations under the head to cut through paint, coatings and oxidation that may be present on the equipment flange. Such equipment shall have minimally one grounding screw per piece of equipment.
10. Existing (installed) racking systems containing live active equipment may be retrofitted for Standards-compliant bonding using rack retrofitting kits listed in the "Materials" section of this document.
11. ESD (electro-static discharge) ports and wrist straps shall be provided minimally every other rack or bay to be within reach of any active equipment. On larger 4-post racks or cabinets - ESD ports and wrist straps shall be installed on the front and back to be accessible when servicing any active equipment.
12. As a condition of employment, any internal or contracting technicians servicing active equipment must be wearing a properly grounded wrist strap to dissipate ESD charges prior to touching any active equipment.

F. Field Quality Control
1. Contractor shall verify the use of all appropriate bonding accessories in the racking systems such as grounding washers, thread-forming grounding screws and the presence of electro-static discharge ports and wrist straps within reach of all equipment to be maintained.
2. Contractor is responsible for visually verifying sizing and sound installation of the telecommunications bonding backbone including presence of properly sized and installed grounding equalizer conductors between backbones contained in separate risers.
3. Inspecting Contractor shall verify that any conduit longer than 3 feet through which a grounding conductor passes is properly bonded to the grounding conductor as described in this document.
4. During inspections Contractor shall verify compliance with all stipulations specified in this document and compliance with all regulatory references (Standards and Codes) cited.
5. All opens or gaps in the bonding system during final inspections shall be recorded in the inspection report and remedied.
6. During inspections, Contractor shall check all grounding and bonding system conductors and connections for tightness and proper installation, including checking proper dies were used on compression taps and fittings by checking embossed die numbers on those connections.
7. Architect and Technology Consultant may request a test of 10% of bonded connections within the grounding system with a volt-ohm meter. Resistance tests taken on either side of a compression or exothermic bond shall be less than .2 (2/10) of one ohm in resistance.
8. Bonded joints to be tested may be random or individually tagged by a representative of Architect or Technology Consultant.
9. Contractor shall Test system at bonded points indicated and provide results in report form.
10. Based upon test results, Architect and Technology Consultant reserves the right to request testing on 100% of exothermic and compression bonds within the installed grounding system.
11. All bonded connections failing the test described above shall be remedied and retested by the installation Contractor at Contractor's expense.

END OF SECTION 27 05 26

SECTION 27 05 29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Provisions and Supplementary Conditions, Specification Sections, apply to this and the other sections of Division 27.

B. This section is a Division 27 BASIC section and is a part of each Division 27 section.

1.2 SUMMARY

A. This Section includes secure support from the building structure for technology items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

B. All support shall utilize threaded fasteners for all technology/attachments
   1. Exception:
      a. Spring steel fasteners may be used in lieu of threaded fasteners only for ¾” raceways above suspended ceilings.

C. Types of supports, anchors, sleeves, and seals specified in this section include the following:
   1. C-clamps
   2. Clevis hangers
   3. Conduit straps
   4. I-beam clamps
   5. Lead expansion anchors
   6. Riser clamps
   7. Round steel rods
   8. Toggle bolts
   9. Wall and floor seals

D. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly, or as specified in Division 26.

1.3 SUBMITTALS

A. Submit the following in accordance with Conditions of Contract and Supplementary Conditions Specifications Sections.
   1. Product Data: Submit manufacturer’s data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve, and seal.
   2. Where multiple products are shown on one cut sheet, circle product to be used.
   3. Shop Drawings: Submit dimensioned drawings of fabricated products, indicating details of fabrication and materials.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacturing of supporting devices, of types, sizes, and ratings requires, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Contractor Qualifications: Firm shall have at least 3 years of successful installation experience with projects utilizing electronic/electrical supporting device work similar to that required for this project.

C. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of supporting devices.

D. MSS Compliance: Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.

E. UL Compliance: Provide components that are UL listed and labeled.

F. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe, and cable.

G. Components shall be listed and labeled by ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturers that are suitable for use in a unified system.

B. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.

C. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.

D. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size, and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Provide supporting devices that comply with manufacturers' standard materials. Install in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Contractor's option.

B. Install hangers, anchors, sleeves, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NEC for installations of supporting devices.
   1. Support all technology cables a minimum of every 5ft. with J-hooks unless other supports are available.
   2. J-hooks shall be rated to carry CAT6A cables
   3. CAT6A cables shall be bundled in groups of 24 cables maximum.
   4. Regardless of the size of the J-hooks, no more than (1) bundle of 24-cables may be placed within a single J-hook.
   5. CAT6 or higher rated cables shall use Velcro type cable ties; zip ties are not permitted.

C. Coordinate with the building structural system and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

D. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

E. Obtain approval from the Architect before drilling or cutting structural members.

F. Install surface-mounted cabinets and panels with minimum of four anchors.

3.2 MISCELLANEOUS SUPPORTS

A. Support miscellaneous technology components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panels, control enclosures, pull boxes, junction boxes, and other devices.

3.3 FASTENING

A. Unless otherwise indicated, fasten technology items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, cabinets, panels, boxes, and control components in accordance with the following:

B. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts, or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

C. Holes cut into reinforced concrete beams or in concrete shall not cut reinforcing bars. If the Contractor cuts into any reinforcing bars, stop work and notify the Technology Consultant immediately. Fill all holes that are not used.

D. Ensure that the load applied to any fastener does not exceed 25% of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

3.4 TESTS

A. Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:

B. Expansion anchors.
   1. Toggle bolts.
   2. Powder-driven threaded studs.

C. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain and submit the Structural Engineer’s signed approval before transmitting loads to the structure. Test to 90% of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

END OF SECTION 27 05 29

SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Continuous, rigid, welded steel or stainless-steel wire mesh cable management system.

B. Cable tray systems are defined to include, but are not limited to, straight sections, supports, and accessories.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Related Sections include the following:
1. Section 27 01 00 - Operation and Maintenance of Communications Systems
2. Section 27 05 26 – Grounding and Bonding for Communications Systems
3. Section 27 05 29 - Hangers and Supports for Communications Systems
4. Section 27 05 53 – Identification for Communications Systems
5. Section 27 08 00 – Commissioning Communications Systems
6. Section 27 11 00 – Communications Equipment Room Fittings
7. Section 27 13 00 – Communications Backbone Cabling
8. Section 27 15 00 – Communications Horizontal Cabling
9. Section 27 16 00 – Communications Connecting Cords, Devices and Adapters

B. References:
1. IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management
2. NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems
3. ANSI/NFPA 70 (2005) – National Electrical Code (NEC)
4. TIA 569-E (2019) – Commercial Building Standard for Telecommunications Pathways & Spaces
5. ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
6. ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless-Steel Parts, Equipment, and Systems
7. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
8. ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
9. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

1.4 SUBMITTALS

A. Comply with requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer’s product data sheets for cable tray indicating dimensions, materials, and finishes, including UL Classification and NEMA/CSA Certification.
1. Where multiple products are shown on one cut sheet, circle product to be used.

C. Shop Drawings: Submit shop drawings indicating materials, finish, dimensions, accessories, layout, supports, splices, and installation details.

D. Design Calculations: Verify loading capacities for supports.

E. Coordination Drawings: Include floor plans and sections drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural and mechanical elements. Data presented on these drawings are as accurate as preliminary surveys and planning can determine. Field verification of all dimensions, routing, etc., is directed.

F. Factory-certified test reports of specified products, complying with IEC 61537, NEC, and NEMA VE 1/CSA C22.2 No. 126.1.

G. Submit manufacturer's certification indicating ISO 9001 quality certified.

H. Submit training procedure for certifying cable tray installers.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Approval and Labeling: Provide cable trays and accessories specified in this Section that are approved and labeled.
   1. The Terms "Classified" pertaining to cable trays (rather than "Listed") and "Labeled": As defined in NFPA 70, Article 100, including painted trays.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. Comply with NFPA 70, National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.

D. Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.

E. Comply with NEMA VE 1/CSA C22.2 No. 126.1, Metal Cable Tray Systems, for materials, sizes, and configurations; provide CSA/US Certificate and labels.

F. Provide documentation of the following certifications:
   1. ISO 9001 quality certification.
   2. American Bureau of Shipping (ABS) Product Design Assessment certification.
   3. E 90 Fire Testing certification.
   4. VDE certification.

1.6 COORDINATION

A. Coordinate layout and installation of cable tray with other installations.
   1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.
   2. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products shall not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials shall be unpacked and dried before storage.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by the following:

1. Cablofil, Inc., 8319 State Route 4, Mascoutah, IL, 62258. Phone: (618) 566-3230. Toll-Free: (800) 658-4641. Fax: (618) 566-3250. Website: www.cablofil.com. Email: Info@cablofil.com.

2.2 MATERIALS AND FINISHES:

A. Cable Tray Materials: select one of the following:
   1. Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.

B. Cable Tray Finishes:
   1. Finish for Carbon Steel Wire after welding and bending of mesh; select one of the following:
      a. Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
   2. Finish for Stainless Steel Wire: According to ASTM B 380.

C. Cable tray shall consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray (including UL Classified painted tray) acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray shall have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers.

D. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
   1. Straight Section Lengths: 120 inches (3,000 mm).
   2. Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray strength; and to allow tray to remain lightweight.
   3. Safe-T-Edge: Patented Safe-T-Edge technology on side wire to protect cable insulation and installers' hands.
   4. Fittings: Wire mesh cable tray fittings are field fabricated from straight tray sections, in accordance with manufacturer's instructions and Item 2.3.
   5. FlexTray Cable Tray Size:
      a. Depth: Cable tray depth shall be 4 inches:
      b. Width: Cable tray width shall be 6, 8, 12, 16, 18, 20 & 24 inches (unless otherwise shown on drawings):
      c. Length: Cable tray section length shall be 120 inches (3000mm) unless otherwise shown on drawings.
      d. Fill Ratio: Cable tray may be filled to total fill capacity per NEC. Minimum 40% spare capacity recommended accommodates future cabling changes or additions.
      e. Load Span Criteria:
      f. Cable tray shall be capable of carrying a uniformly distributed load of 50 pounds per foot on an 8 ft support span, according to load tests of standard shown in Item A above.
   6. Cablofil cable basket/tray part numbers:
      a. CF 105/200: 4 inches height x 8 inches width x 120 inches length
      b. CF 105/300: 4 inches height x 12 inches width x 120 inches length
      c. Or Approved Equals

2.3 CABLE TRAY SUPPORTS AND ACCESSORIES

A. Fittings/Supports: Wire mesh cable tray fittings are field fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports include the FAS (Fast Assembly System) where possible so that screws, bolts, and additional tools are not required for cable tray mounting; installation time is reduced; and tray path can adapt to installation obstacles without the need for additional parts. Place supports so that support span does not exceed that shown on the drawings.
   1. FAS system support methods to mount from ceiling and wall structures with 1/4", 3/8" or 5/8" threaded rod, where applicable. Select one of the following support accessories:
      a. FASP trapeze hung supports for tray in ceiling and/or wall mounted applications. For trapeze hung installations, use a FAS Profile that is 4" longer than the tray width.
      b. FASL supports for tray in wall-mounted applications
      c. Center hung, single threaded rod supports (i.e., Cablofil FASPCH) shall not be used.

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2. Splices including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer. Select one of the following splicing methods, if applicable:
   a. UL: Classified FTSTLC Tab-Loc Connectors: No hardware required
   b. UL Classified FTSCH: Connecting Hardware Swaged set for splicing, turns, bends and tees
   c. UL Classified SPLICE BAR Universal Splice Bar: Cut & bend to fit any configuration]
   d. Preclick Splice: Bolted connection optional]
   e. UL Classified FTSBK Splice Plate: Bolted connection
   f. UL Classified CE 25 & CE 30 Square Splice Washers: Use with EZ BN ¼” Nut & Bolt
   g. UL Classified CE 40 Square Splice Washer: Use with EZ BN ¼” to splice trays on bends, adjustable tees
   h. FASLock Splice: For sweeps and bends with tray 12” (300mm) and wider.
   i. UL Classified 90 DEGREEKIT: For Tees and 90s
   j. UL Classified RADT90 kit: For 5-1/2” radius Tees and 90s
   k. Cable Routing Accessories:
   l. Dropout: Bolt to tray; slotted design.
   m. Cablexit: No additional hardware needed.
   n. GROUND BOLT: Grounding Clamp to ground cable tray.

2.4 EQUIPMENT GROUNDING CONDUCTOR FUNCTION AND GROUNDING

A. UL Classified cable trays (including painted tray) may act as Equipment Grounding Conductors.
   1. Use UL Classified splicing methods to ensure cable tray is electrically continuous and bonded as recommended by COOPER B-Line.
      a. Ground cable trays at each joining section and end of continuous run.
   2. Test cable tray system per NFPA70B, Chapter 18 to verify grounding less than 1 ohm.
   3. Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10’ cable tray section with grounding clamp. COOPER B-Line GROUND BOLT.

PART 3 EXECUTION

3.1 EXAMINATION:

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cable tray level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
   1. Cutting: Field-fabricate changes in direction & elevation by cutting & bending cable tray.
      a. Cut cable tray wires in accordance with manufacturer’s instructions.
      b. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
      c. Remove burrs and sharp edges from cable trays.
   2. Certified Installers: Cable tray installers must have successfully completed Manufacturers Certified Installer program.
   3. A minimum of 9-inches shall be observed between the cable supports and the finished ceiling.
   4. A minimum of 12-inches shall be observed above the cables and cable supports.
   5. A minimum of 12-inches shall be observed on one side of the cable supports.

B. It is recommended that plumbing joints are not located above the cable tray where possible. All valves, including but not limited to pressure, check, control and access, shall not be located above cable tray. Valves shall remain fully accessible for complete and functional operation from the service position.

END OF SECTION 27 05 36

SECTION 27 05 53 - IDENTIFICATION FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

1.2 SUMMARY

A. This section relates to the Structured Cabling Sections of this specification.

B. This Section includes requirements for identification of components including but not limited to the following:
   1. Identification labeling for cables and conductors
   2. Operational or instructional signs
   3. Equipment labels

C. Refer to project drawings and other Division 27 sections for additional specific identification associated with the specific items.

D. Labeling shall be consistent. Please ensure labeling corresponds to the final room number which may be different than the Architect's number scheme on the construction documents.

E. Comply with the ANSI/TIA-606-D, "The Administration Standard for the Telecommunications Infrastructure".

F. The Contractor shall submit, for approval by the Technology Consultant and Owner, a labeling system for the cable installation. The Owner shall coordinate the exact verbiage of the labeling scheme with the successful Contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cabinets, ground bars, cables, panels, and outlets. The labeling system shall designate the cable origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings, and all test documents shall reflect the appropriate labeling scheme.

G. All label printing shall be machine generated using indelible ink ribbons or cartridges. Self-laminating labels shall be used on cable jackets, appropriately sized to the OD of the cable, and placed within the view at the termination point on each end. Outlet, patch panel and writing block labels shall be installed on, or in the space provided on the device.

1.3 ABBREVIATIONS

A. BET – Building Entrance Terminal

B. BDF – Building Distribution Frame

C. IDF – Intermediate Distribution Frame

D. TDMM – Telecommunications Distribution Maintenance Manual

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E. OD – Outside Diameter

F. UL – Underwriters Laboratory

1.4 SUBMITTALS

A. Submit the following in accordance with Section 27 01 00 Operation and Maintenance of Communications Systems:
   1. Manufacturer's data for each type of product specified.
   2. Schedule of identification and nomenclature to be used for identification labels.
   3. Samples of each color, lettering style and other graphic representation required for identification materials.

B. Labeling conventions for copper and fiber optical cable and terminations shall be approved by the Owner's IT Department prior to installation.

C. The Technology Consultant's review of shop drawings or samples shall not relieve the Contractor of responsibility from receiving final approval from IT Department

1.5 QUALITY ASSURANCE

A. All work shall be in accordance with the general principles outlined in the BICSI TDMM manual latest edition and with the TIA-526, TIA-568.2-E and TIA-606-D Standards.

B. UL Compliance: Comply with the applicable requirements of the UL Standard 969. "Marking Systems," with regards to type and size of lettering for raceways and cable labels.

C. NEMA Compliance: Comply with applicable requirements of NEMA Standards WC-1 and WC-2 pertaining to identification of power and control conductors.

D. Major items of equipment shall have manufacturer's name, address and catalog number on the plate securely attached in a convenient place.

1.6 SUGGESTED NUMBERING AND LABELING SCHEME

A. All labeling/color schemes for the structured cabling shall conform to the standards as set forth and confirmed by the Van Buren Township IT Department.

B. Workstation Cable Numbering:
   1. Faceplate labeling shall be consistent with that of the other buildings on the campus. Provide labeling per Owner's directions.
   2. There shall not be any open places on the patch panel.
   3. Terminate all outlets from the same room sequentially on the same patch panel.
   4. If an outlet is added, it gets a new number that is next on the sequence even if it is on an existing faceplate.
   5. Labeling techniques: The label shall be black letters on white background. Labels must be produced by label-making equipment. The blank white label tags that are included in the faceplate hardware are to be installed with clear plastic shields in all positions on the faceplate.

C. Workstation Cable Numbering Standard: AA-BB-C-DD-A/B/C/D
   1. AA= Building Number
   2. BB= Floor that the Telecommunications Room resides
   3. C= Patch panel number
   4. DD= Patch panel port position

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5. A/B/C/D= Faceplate position

1.7 RISER CABLES

A. Number scheme: Riser cables must be assigned specific numbers. Each shall be tagged with the building abbreviation and room number of the BET/IDF at both ends of the cable clearly shown.

B. Labeling techniques: Each cable is to be labeled on each end within 6” of where it terminates on the cross-connect panel. Cable tags must be securely fastened to the cable sheath. Wrap around tags protected by clear polyurethane tape may be used as well. Tags must be typed and be permanent. Cable tags that appear less than permanent shall not be accepted. Directly writing on the cable sheath shall not suffice as proper labeling of the riser cables.

1.8 UTP CABLING CROSS-CONNECT BLOCKS

A. Numbering scheme: 25 pair cables from the Utility RJ21X blocks are terminated on blocks. Cable pairs are numbered in 25 pair increments. The first cable is numbered 1-25, the second 26-50, etc. Pair #1 is terminated on the left position of the top block. Subsequent cable pairs are terminated from left to right and from top to bottom.

B. Labeling technique: The first label block shall read, “Cables to RJ21X blocks, 1-25”. Subsequent label blocks shall denote the same for pairs 26-50, etc. The label shall be black letters on white background. Labels must be produced by label-making equipment. Handwritten labels are not allowed.

1.9 FIBER OPTIC PANELS

A. Numbering scheme: Fiber optic cables and terminations shall be numbered and labeled per current TIA Standards. The numbering scheme denotes the cable function (campus backbone, building entrance, or intrabuilding), sheath number, and buffer tube number.

B. Labeling techniques: A label shall be installed onto the outside of the front face of the connector housing to read “Horizontal fiber optic cables to outlets” or “Entrance/riser fiber optic cables” as appropriate. Labels must be produced by label making equipment. Handwritten labels are not permitted. Horizontal fiber optic cables shall be labeled on the label tags on the closet connector housing. Each cable terminated shall be labeled with the following information: type of fiber optic cable and outlet number. For example, a label block for a multimode horizontal fiber optic cable termination might read “MM-17”. Terminations are numbered by the outlet number, not the housing or connector panel position number. Only adapter positions that are terminated are labeled.

1.10 OSP FIBER OPTIC CABLES

A. Numbering scheme: The numbering scheme denotes the cable function (campus backbone or building entrance). Each fiber optic cable sheath shall be tagged in each BET and IDF with the number and type of strands in the sheath (i.e., 12SM/12MM) and the building name of the far end of the cable clearly shown. In each intermediate maintenance hole or hand hole each cable sheath shall be tagged with the number and type of strands in the sheath and the building name of each of the cable endpoints clearly shown.

B. Labeling technique: Each cable is to be labeled within 36” of where it enters each BET or IDF. Cable tags may be cloth or plastic tape securely fastened to the cable sheath. Wrap around tags protected by clear polyurethane tape may be used as well. Tags must be typed or permanent. Cable tags that appear less than permanent shall not be accepted. Directly writing on the cable sheath shall not suffice as proper labeling. In intermediate maintenance holes and hand holes, one wrap-around cable marker shall be

installed on each cable sheath. Markers shall have a clear Mylar covering reading “Fiber Optic Cable-Caution” with space for cable designation. Cable markers shall be orange in color. Other types of tags, tapes or sheath marking are not acceptable.

1.11 EQUIPMENT RACKS

A. Numbering scheme: Each rack is numbered sequentially denoting the following information: BET/IDF room number, and rack number. There is no correspondence between the rack equipment and configuration (type) and the rack number. Unique rack number example:
   1. 1.1 = Row 1, Rack 1
   2. 1.2 = Row 2, Rack 2
   3. 2.1 = Row 2, Rack 1
   4. 2.2 = Row 2, Rack 2

B. Labeling techniques:
   1. Two labels shall be installed onto the front face of each equipment rack, one at the bottom of the rack, and one at the top.
   2. All labels shall be black letters on white background.
   3. Provide engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver’s standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening

1.12 TELECOM ROOM ELECTRICAL RECEPTACLES

A. Each electrical receptacle in MDF/IDFs shall be labeled with the following information: room number where electrical panel is located, panel number, and circuit number. Each receptacle is to be labeled on top or front of the faceplate or outlet box. Preprinted adhesive labels or tags shall be used.

PART 2 PRODUCTS

2.1 TECHNOLOGY IDENTIFICATION PRODUCTS

A. Cable/Conductor Identification Bands:
   1. Provide Manufacturer’s standard wrap-around cable/conductor markers, of size required for proper application, and numbered to show circuit identification.

B. Equipment Labels
   1. General: Provide engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver’s standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening.
   2. Thickness: 1/16”, for units up to 20 sq. in. or 8” length; 1/8” for larger units.

C. Lettering and Graphics
   1. Coordinate names, abbreviations, and other designations used in technology identification work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the technology systems and equipment.
   2. Fasteners for Plastic-Laminated Signs shall be self-tapping stainless-steel screws or number 10/32 stainless steel machine screws with nuts and lock washers.
   3. Exception: Where specifically approved contact type permanent adhesive may be used where screws cannot or should not penetrate substrate.

PART 3 EXECUTION

3.1 GENERAL

A. Except as otherwise indicated, provide manufacturers' standard products of categories and types required for each application.

B. The Contractor shall be responsible to adapt their labeling and identification system to match the existing standards of Van Buren Township and meet those standards to the Owner's satisfaction.
   1. The Contractor shall procure a copy of the Owner's detailed labeling & identification standards and shall follow those standards as directed.

C. Lettering and Graphics
   1. Coordinate names, abbreviations, colors, and other designations used in technology identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as reviewed in submittals and as required by standards.

D. Install identification devices as indicated, in accordance with manufacturers' written instructions.

E. Sequence of work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.2 TECHNOLOGY ROOM IDENTIFIER

A. The Technology Rooms (Communications Distribution rooms) shall be identified with three (3) distinct identifiers:
   1. Room number
   2. IDF Identifier
   3. POP Identifier

3.3 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/cable conductor identification on each cable/conductor at each end and in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with the marking system used on shop drawings, contract documents, and similar previously established identification for project's technology work.

3.4 OPERATIONAL SIGNS

A. Provide instructional signs with approved legend where instructions or explanations are needed for system or equipment operation.

3.5 OUTLET IDENTIFICATION

A. Label each voice and data outlet with the proper designation and provide appropriate icon.

B. The RJ45 jacks shall have the following basic color coding:
   1. Data & Voice = Gray

3.6 INSTALLATION

A. Provide equipment identification labels of engraved plastic-laminate on all equipment racks and on major units of technology equipment in buildings. Except as otherwise indicated, provide single line of text, with

½-inch high lettering on 1-½-inch high label (2-inch high where two lines are required), white lettering in black filed. Text shall match terminology and numbering of the Contract Documents and shop drawings.

B. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment

END OF SECTION 27 05 53

SECTION 27 08 00 - COMMISSIONING COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Provisions and Specification Sections, apply to this and the other sections of Division 27.

B. This section relates to the Structured Cabling Sections of this specification.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for the structured cabling system and campus inter-building distribution systems. It includes terminations and testing parameters. Reference individual sections for further expansion of these requirements.

B. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable to electronic and electrical installations.

C. The following industry standards are the basis for the structured cabling system described in this document.

1.	TIA-568.1-E	Commercial Building Telecommunications Cabling Standard
2.	TIA-568.2-E	Balanced Twisted Pair Cabling Components Standard
3.	TIA-568.3-E	Optical Fiber Cabling Components Standard
4.	TIA-568.4-E	Broadband Coaxial Cabling and Components Standard
5.	TIA-569-E	Commercial Building Standard for Telecommunications Pathways
6.	TIA-606-D	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
7.	TIA-607-E	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
8.	NFPA	National Fire Protection Association
9.	NFPA 70	National Electric Code (NEC)
10.	ISO/IEC	International Organization of Standards/International Electrotechnical Commission
11.	ISO 11801-1	Generic Cabling Requirements for Twisted Pair and Optical Fiber Cables

D. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

E. This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

PART 2 PRODUCTS

2.1 QUALITY ASSURANCE PARAMETERS

A. All work shall be performed in accordance with these guidelines, current industry testing standards, and with the test equipment manufacturer’s recommendations. All work shall be in accordance with the general principles outlined in the BICSI TDMM manual, latest edition. The system shall be Ortronics certified through the Clarity Warranty Authorization System.

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B. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturers that are suitable for use in a unified system.

C. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.

D. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Owner and Technology Consultant.

E. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size, and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

PART 3 EXECUTION

3.1 UTP CABLE TESTING

A. Riser and campus distribution cable testing: Each cable pair within all UTP riser cables shall be tested for continuity to ensure conductors are terminated in proper sequence, with correct polarity (tip and ring), and without conductor-to-conductor shorts, conductor-to-ground shorts, or opens.

B. Horizontal cable testing: All UTP station cables shall be tested to prove compliance with the current industry standard, TIA-568.2-E-1 Part 2: Balanced Twisted Pair Cabling Components, Addendum – Transmission Performance Specifications for 4-pair 100 Ω CAT6A Cabling and any subsequent addenda. Permanent Link tests are the only acceptable test format for testing Category 6 cabling or Channel tests are the only acceptable test format for testing CAT6A cabling.

C. Horizontal cable testing equipment: The testing of UTP station cables shall be performed using the recommended test equipment specifically designed to test cables for all parameters from 0 – 500 MHz. Testers shall be loaded with the most recent test values per the above referenced standard. The Contractor shall be required to provide current calibration and firmware release for the test equipment to be used.

D. The field test equipment shall meet the requirements of ANSI/TIA-568-E including applicable Technical Service Bulletins and amendments. The appropriate level III tester shall be used to verify CAT6A cabling systems.

3.2 FIBER OPTIC CABLE TESTING

A. Inter-building cable testing requirements:
   1. Bi-directional direction.
      a. Test multi-mode strands at 850 nm and 1300 nm.
      b. Test single-mode strands at 1310 nm and 1550 nm.
      c. Use optical time domain reflectometer (OTDR) and power meter for tests.
      d. Record the following at the above frequencies:
      e. Signature trace
      f. Length
      g. Polarity
      h. End to end attenuation

2. Fiber optic cables: Test results for fiber optic cables shall consist of the measured attenuation, the maximum attenuation allowed per these guidelines, and whether the test passed or failed for each fiber optic cable link.
3. Provide test report and include as a minimum the following information for all cables:
   a. Fiber cable number
   b. Fiber length.
   c. Attenuation (loss in dB)
   d. Test date
   e. Tester make and model number
   f. Tester calibration date
4. The maximum optical attenuation per connector pair for multimode fiber connectors shall be 0.3 dB or less when measured at 850/1300 nm in accordance with ANSI/TIA-526-14A, Method A-1. Maximum optical attenuation per connector pair for singlemode fiber connectors shall be .05 dB or less when measured at 1310/1550 nm in accordance with ANSI/TIA-526-7-A, Method B. Reflection shall be ≥ 45dB.
5. Provide test results in an approved format.

3.3 TEST RESULTS

A. Provide test results for acceptance in an approved format.

B. Provide test results for CAT6A cables in an approved format and include the following:
   1. Graphical/numerical data. Both graphical data plots and numerical data are required for the following test parameters:
      a. NEXT
      b. PS NEXT
      c. ELFEXT
      d. PS ELFEXT
      e. Attenuation
      f. Return loss
   2. Numerical data. Numerical data only is required for the following test parameters:
      a. Propagation delay
      b. Delay skew
      c. Resistance
   3. The CAT6A Horizontal Cable Certification reports shall have complete testing of Permanent Link at frequency increments up to 500 MHz as indicated in TIA-568-E and shall include the following:
      a. Cable/Faceplate Number - matching faceplate numbers on patch panels
      b. Test Date
      c. Cable Length
      d. Wire-Map
      e. Network Tests for 100BASE-TX and 1000BASE-T
      f. Attenuation
      g. Near End Crosstalk (NEXT)
      h. Power-sum NEXT (PS-NEXT)
      i. Attenuation to Cross Talk Ratio (ACR)
      j. Power-sum Attenuation to Crosstalk Ratio (PS-ACR)
      k. Equal Level Far End Crosstalk (ELFEXT)
      l. Power-sum Equal Level Far End Crosstalk (PS-ELFEXT)
      m. Return Loss
      n. Propagation Delay
      o. Delay Skew
      p. Signal to Noise Ratio
   4. Testing of horizontal cabling shall not be performed on test equipment with marginal pass/fail notification disabled. If the tester is capable of indicating tests that pass with a measured value closer to the limit than the guaranteed accuracy of the tester, the test result shall be marked (typically as Pass* or Fail*).
   5. Marginal pass results shall not be accepted. Contractor shall correct issue and retest at no expense to the Owner.

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C. UTP riser cables: Continuity and Wire Mapping tests shall be performed on each pair. The Contractor shall submit a document detailing termination errors, open, short, split pairs, and confirming that these trouble cable pairs were corrected and tested satisfactorily per these guidelines.

3.4 SYSTEM DOCUMENTATION

A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant a complete set of documents that clearly represent all contract work “as-built.” This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation.

B. The Contractor shall submit, within forty (40) working days of the completion of each phase, three (3) full sets of As-Built documentation to the Technology Consultant for review. Prior to delivery, each document section and each drawing shall be signed and dated by the Contractor’s project manager attesting to the accuracy of the as-built documents.

C. Provide a record of the Work as constructed in an approved format. Include, at minimum, equipment locations, cable routes, and outlet locations. Clearly indicate any deviations from the Contract Documents.

D. The Contractor shall provide, in the BDF, a full-size laminated or similarly framed copy of the drawing which clearly provides an “in-room” roadmap of the voice/data drops that are served from within that space, respectively. The final product shall be coordinated with the IT Department staff so as to follow Owner standards.

E. Note -Digital drawing files may be provided to the Contractor at no cost for use in the development of Shop Drawings or As-Built drawings under separate agreement between Contractor and Consultant.

F. Provide test results and other documentation in an open, industry-standard format. The documents shall be readable without requiring proprietary software. Where this is unavailable, provide a licensed cope of the software required to view the documentation.

G. The As-Built drawings shall include outlet locations. Their sequential number, as defined elsewhere in this document, shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. These documents shall be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Technology Consultant.

H. The Technology Consultant may request that a 5% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Architect or Technology Consultant, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

I. Test Results documentation shall be clearly marked on the outside front cover with the words “Project Test Documentation,” “Community Center Building” and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, and reference setup. The test equipment name, manufacturer, model number, serial number, software version, and calibration date shall also be provided at the end of the document. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

J. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.5 FINAL PUNCH LIST SCHEDULING

A. The Contractor shall request a final punch list appointment by completing a “Pre-Punch Verification Form” and returning it to the Consultant. By signing the form, the Contractor indicates that:
   1. The work on this contract, as defined in the Telecommunications Drawings and Division 27 Specifications, is complete and ready for the Consultant’s final punch list.
   2. Test results have been submitted to the Consultant for approval.

B. If the Contractor’s work is found to be incomplete, and subsequent visits to the site by the Consultant are required by the Owner, the Owner may elect to have the Consultant’s travel costs, billable time, and all other related travel expenses be borne by the Contractor.

END OF SECTION 27 08 00

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SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

1.2 SUMMARY

A. This Section includes the following:
   1. Cable Management
   2. Entrance protection for copper
   3. Floor-standing equipment racks
   4. Mounting of Owner-furnished equipment in equipment racks
   5. Rack mounted power protection and power strips
   6. Terminal blocks and patch panels

B. Refer to following Specification Sections:
   1. Division 6 Section “Rough Carpentry” for wood framing and blocking for installation of wall-mounted equipment racks.
   2. Division 7 Sections for fire-stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
   3. Division 26 Sections for supports, anchors, identification products, electrical service, and connections.

C. Provide cabinets and racks in accordance with the Contract Documents. Where conflicting data is indicated, verify mounting and equipment requirements prior to ordering.

D. This section contains specific parts selected by Owner and Technology Consultant. In the event that the parts specified are not available, Owner and Technology Consultant shall be contacted to specify replacements.

1.3 COORDINATION

A. This Contractor shall be responsible for all coordination with the general and electrical contractor and data and voice vendors to provide a complete operational system.

B. Coordinate layout and installation of equipment racks with adjacent construction.

1.4 SUBMITTALS

A. Product Data: For copper protection devices, cabinets and equipment racks, termination blocks and patch panels, cable management devices, UPSs, and power strips.
   1. Where multiple products are shown on one cut sheet, circle product to be used.

B. Shop Drawings: Show fabrication and installation details of components for cabinets, equipment racks, and their associated parts and pieces to make a complete system.

C. Show rack elevations for review by the Owner and Technology Consultant.

D. Allow sufficient time in project scheduling for Owner and Technology Consultant review.

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E. Submittals shall be checked by the supplier and made as complete systems including all required accessories and any special tools.

F. Manufacturer's installation and maintenance instructions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of enclosure through one source from a single manufacturer.

B. All work shall be in accordance with the latest edition of all applicable State and Federal regulations and codes. Further, all work shall also be in accordance with TIA Standards, the BICSI TDMM manual, latest edition and with the manufacturer’s recommendations.

1.6 SEQUENCING AND SCHEDULING

A. Sequence all work to support the installation of the structured cabling system, electrical work, and all cable tray systems installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available manufacturers are listed in subparagraphs for each Part 2 article below.

B. Proposed substitutions shall be submitted WITH THE BID and must be approved by the Owner and Technology Consultant.

C. Requests for substitution are only permitted for materials specified with an "or approved equivalent" clause or other language of same effect in the Contract Documents.

2.2 ENTRANCE PROTECTION

A. Shall be wall-mounted 110-type.
   1. Use Circa Telecom, Part #1880ENA1/NSC-50 or approved equivalent

B. Acceptable manufacturers are:
   1. Avaya
   2. Circa Telecom,
   3. Marconi
   4. TII Network Technologies
   5. Approved equivalent

C. All protection modules are to be solid state.

D. Acceptable modules are:
   1. Circa Telecom, Part # 4B1S-300 or approved equivalent

E. Provide a tie cable from the protector block to a rack-mounted 110 panel.
   1. Use Ortronics Panel, Part #OR-302003251

2.3 RACKS

A. Floor Distribution Frame: for rack mounted installations in Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) Rooms, the installer shall use a 7-foot high 19-inch equipment rack.

B. The racks shall:
   1. Be made by an ISO 9001 and 14001 Certified Manufacturer.
   2. Have cable access holes on side rails, which allow cables to be routed between adjacent racks.
   3. Have standard 19-inch EIA/ECA-310 mounting holes having a full 45 RU on front and back of rails.
   4. The racks shall have floor mounting holes and a ground lug for 0-6 gauge ground cable provided.
   5. Use CPI/Chatsworth Products Inc., Part #66353-703.
   6. Ensure product submittal includes all accessories and ensures system compatibility.

2.4 VERTICAL CABLE MANAGERS

A. The racks shall have vertical cable management channels 6” W x 6.38” D x 7’H. Channels shall be located between racks and on the end of each row. The channel shall include cable retainers, which can be hinged left or right and be located in any position along the channel.

B. The vertical cable managers shall utilize black grommets at all cable openings, including unused cable openings.
   1. Use CPI/Chatsworth Product Inc., Part #13704-703

C. Ensure product submittal includes all accessories and ensures system compatibility.

2.5 HORIZONTAL CABLE MANAGER

A. Provide horizontal cable managers, 2 RU in height. Provide one horizontal cable manager per patch panel. Mount above and below switches and/or between switches as directed by the Owner or Technology Consultant.
   1. Use CPI/Chatsworth Product Inc., Part #30130-719

2.6 RACK MOUNT POWER STRIP

A. Provide rack-mounted power strips 1 RU in height with 8 outlets and 10’ cord.
   1. CPI/Chatsworth Product Inc., Part #13239-753. Provide one per rack.

2.7 CABLE LADDER RUNWAY

A. Cable runway shall be included as shown and as required for cable routing and overhead seismic restraint.

B. Provide cable runway radius drops, pathway dividers, junctions, splices, supports, and all necessary appurtenances for a complete installation.

C. Cable runway mounted over racks shall be designed specifically for use over 19” wide racks and vertical cable managers wherein the runway cross-members are spaced to align over the vertical cable channels.

D. Cable runway for telecommunication room usage other than specified above shall be:
   1. CPI Part #10250-712 where 12” ladder is indicated on drawings.

PART 3 EXECUTION

3.1 LIGHTNING PROTECTION

A. All copper cables, either multi-pair or coaxial, are to be terminated on lightning protection within 50 feet of the entrance into the building.

B. All pairs of inter-building twisted pair copper cable are to be protected on both ends to lightning protection blocks.

C. Lightning Protection Blocks are to be grounded to the nearest Telephone Main Grounding Bar (TMGB) or Telephone Grounding Bar (TGB).

3.2 RACKS

A. Preparation
1. Coordinate requirements for riser bases, raised floor riser feet, anchors, bracing, and blocking to ensure adequate means for installation of racks/cabinets.
2. Coordinate requirements for electrical cable pathways from overhead cable trays and management systems.

B. Installation
1. Install racks in compliance with manufacturer's written instructions and shop drawings.
2. Floor-standing racks/cabinets in the telecommunication rooms shall be securely attached to the concrete floor using minimum 3/8” in diameter hardware utilizing an approved length.
   a. Contractor shall abide by any regional seismic requirements for rack type and installation.
3. Install equipment racks at locations and heights indicated on Drawings. Rows of racks/cabinets shall be placed with a 36-inch (minimum) clearance from the walls on all sides of the rack, unless otherwise indicated on Drawings. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks/cabinets. Where racks/cabinets are shown side by side, securely connect together using manufacturer’s ganging hardware to provide a stable system. Supply all miscellaneous parts and pieces to make a complete system.
4. Rack and runway installation shall comply with local seismic bracing requirements.
5. All racks/cabinets shall be grounded to the ground bus bar in accordance with the drawings and other Sections of this document.
6. Rack mount screws not used for installing patch panels, keys and other hardware shall be bagged and left with the rack upon completion of the installation.
7. Horizontal wire managers shall be installed between patch panels as described in Section 271600. The Contractor shall provide an equal number of wire managers in the electronics racks as was required for the patch panels and install them in the same configuration for the Owner to use with their electronics.
8. Vertical cable managers shall be installed on both sides (left and right) of each rack in the telecommunications rooms.
9. Horizontal cable jumper tray shall be in the uppermost position and have the radius section adjusted to transition optical fiber to the vertical cable channel.

3.3 OWNER FURNISHED EQUIPMENT

A. Owner furnished in the Community Center Building by others including:
1. Network Switches
2. UPS and batteries
3. Wireless Access Points
4. IP Cameras
5. VoIP Telephones

END OF SECTION 27 11 00

SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

B. This section is inclusive to all Division 27 sections.

C. Division 7 Sections for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

1.2 DRAWINGS

A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.

B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

1.3 SCOPE OF WORK

A. General
1. This project includes the installation of fiber and copper cables.
2. All UTP terminations must follow 568B wiring schematic.
3. All copper cabling shall be manufactured by Ortronics.
4. All fiber optic cabling shall be manufactured by Corning.

B. The Contractor shall provide a complete structured cabling system to accommodate voice, and data for all rooms defined in scope.

C. Inter-Building Backbone Cabling (OSP)
1. Fiber Optic Cabling:

D. Intra-Building Backbone Cabling
1. Fiber Optic Cabling:
   a. Install (1) new 12-strand single-mode cable and (1) new 24-strand multimode from the Community Center MDF to the IDF.
   b. Terminate fiber in new rack mounted OSP fiber distribution shelves with LC panels and connectors in Community Center MDF & IDF as indicated on the drawings.
2. Copper Cabling:
   a. Install (1) new 25-pair copper cable from the Community Center MDF to the IDF.
   b. Terminate copper on new wall mounted 110-blocks in Community Center MDF and to rack-mounted 24-port patch panels in the IDF as indicated on the drawings.
   c. Be appropriate for the environment in which it is installed.

PART 2 PRODUCTS

2.1 GENERAL

A. Available manufacturers are listed in subparagraphs for each Part article below.

B. Proposed substitutions shall be submitted WITH THE BID and must be approved by the Owner and Technology Consultant.

C. Request for substitutions are only permitted for materials with an “or approved equivalent” clause or other language of the same effect in the “Contract Documents.

2.2 BACKBONE CABLING

A. Cables allowed for use in the intra-building backbone include fiber optic cables. The cable shall support voice, data, and imaging applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.

B. All UTP cables shall conform to ANSI/TIA-568-E Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard.

C. Multimode 24-fiber shall be:
   1. Corning, Part #PDP024EB3010/25-HE(BLA) or approved equivalent

D. Single-Mode 12-fiber shall be:
   1. Corning, Part # PDP012AB0707-HE(BLA) or approved equivalent

E. Fiber terminations shall be Ortronics OptiMo FC Series and:
   1. Ortronics Patch Cabinet, Part #OR-FC01U-P
   2. Ortronics Duplex Multimode Adapter Panels, Part #OR-OFP-SCD12LC
   3. Ortronics Duplex Single-Mode Adapter Panels, Part #OR-OFP-SCD06AC
   4. Ortronics SC-Type MM Connectors, Part #OR205KAS9FA-50T
   5. Ortronics SC-Type SM Connectors, Part #OR-205KAS9FA-09

PART 3 EXECUTION

3.1 SITE SURVEY

A. Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions shall not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

3.2 PHYSICAL INSTALLATION

A. Industry requirements: The following installation, documentation, component, and system industry specifications shall be met or exceeded:
   1. ANSI/TIA-526-7-A “Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant”.
   2. ANSI/TIA-526-14-D “Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant”.
   3. ANSI/TIA-568.1-E and addenda “Commercial Building Telecommunications Cabling Standard - General Requirements”.
   4. ANSI/TIA-568.2-E and addenda “Commercial Building Telecommunications Cabling Standard - Balanced Twisted Pair Cabling and Components Standard”.
   5. ANSI/TIA-568.3-E and addenda “Commercial Building Telecommunications Cabling Standard - Optical Fiber Cabling and Components Standard”.
   6. ANSI/TIA-568.4-E and addenda “Commercial Building Telecommunications Cabling Standard - Broadband Coaxial Cabling and Components Standard”.

7. ANSI/TIA-569-E and addenda “Commercial Building Standard for Telecommunications Pathways and Spaces”.
8. ANSI/TIA-606-D and addenda “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”.
9. TIA-607-E and addenda “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”.
10. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments “Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling”.
11. ISO/IEC 11801:2000 Ed1.2 and amendments “Information technology - Generic cabling for customer premises”.
12. CENELEC EN 50173:2000 and amendments “Information Technology - Generic cabling systems.”

B. Cable Pathways
1. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
2. Grounding and bonding of pathways shall comply with applicable codes and regulations.
3. Pathways shall not have exposed sharp edges that may come into contact with telecommunications cables.
4. The number of cables placed in a pathway shall not exceed manufacture specifications, nor shall the geometric shape of a cable be affected.

C. Cable Routing
1. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5m (5ft) apart.
2. Telecommunications pathways, spaces, and metallic cables, which run parallel with electric power or lighting, which is less than or equal to 480 Vrms, shall be installed with a minimum clearance of 50mm (2in).
3. The installation of telecommunications cabling shall maintain a minimum clearance of 3m (10ft) from power cables in excess of 480 Vrms.
4. No telecommunications cross-connects shall be physically located within 6m (20ft) of electrical distribution panels, step down devices, or transformers, which carry voltages in excess of 480 Vrms.
5. In the telecommunications rooms where cable trays or cable racking are used, the Contractor shall provide appropriate means of cable management such as reusable color-coded hook and loop cable managers (ties) to create a neat appearance and practical installation.
6. In a false ceiling environment, a minimum of 9-inches shall be observed between the cable supports and the false ceiling.
7. Continuous conduit runs installed by the Contractor should not exceed 30.5m (100ft) or contain more than two (2) 90-degree bends without utilizing appropriately sized pull boxes.
8. Maximum conduit pathway capacity shall not exceed a 40% fill. However, perimeter fill is limited to 60% fill for move and changes.

D. Backbone pathways shall:
1. Be installed or selected such that the minimum bend radius of backbone cables is kept within manufacturer specifications both during and after installation.
2. Have adequate riser sleeve/slot space available with the ability to ingress the area at a later date in all Telecommunications Rooms, such that no drilling of additional sleeves/slots is necessary.

E. Pulling Tension
1. The maximum cable pulling tensions shall not exceed manufacturer’s specifications.

F. Bend Radius
1. The maximum cable bend radii shall not exceed manufacturer’s specifications.
2. In spaces with UTP cable terminations, the maximum bend radius for 4-pair cable shall not exceed four times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
3. During the actual installation, bend radius on 4-pair cable shall not exceed eight times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.

G. Slack/Service Loop
   1. In telecommunications rooms a minimum of 6m (20ft) of slack should be left for all cable types. This slack must be neatly managed on plywood walls fields in locations as shown on drawings.

H. Cable Wraps
   1. Hook and loop cable managers should be used in the telecommunications rooms where reconfiguration of cables and terminations may be frequent.

I. Grounding
   1. Grounding and bonding shall be done per applicable codes and standards.

J. Cable Protection
   1. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

K. Fire Protection
   1. Properly installed firestop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, or raceways.
   2. Fire stops shall comply with all applicable codes.

L. Workmanship
   1. All work shall be done in a workman like fashion of the highest standards in the telecommunications industry. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed. Workers must clean any debris and trash at the close of each workday.

END OF SECTION 27 13 00

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. This section is inclusive to all Division 27 sections.

1.2 DRAWINGS

A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.

B. All work shall be subject to the Owner's direction and approval.

1.3 SUBMITTALS

A. The Contractor shall provide product submittals for all system components as defined in Part 2 of this specification section. These components shall include all structured cabling and associated structured cabling components. The selected Contractor shall allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant.

1.4 SCOPE OF WORK

A. The campus network cabling solution shall be based upon structured cabling system components manufactured by Clarity and allied manufacturers. This may include but not be limited to cable management, faceplates, copper and fiber modules, patch panels, racks, 110-type blocks, patch cords, labels, and grounding hardware.

B. All UTP terminations shall follow 568B wiring schematic

C. All copper cabling shall be manufactured by Ortronics.

D. The installed system shall meet all the requirements necessary to achieve certification for the Clarity.

E. The Contractor shall provide a complete structured cabling system to support voice, data, security, and video applications for the building.

F. Contractor shall provide outlets as identified in this specification or indicated on the drawings.

PART 2 PRODUCTS

2.1 HORIZONTAL CABLING

A. General
   1. Available manufacturers are listed in subparagraphs for each PART 2 article below.
   2. Proposed substitutions shall be submitted WITH THE BID and must be reviewed by the Owner and Technology Consultant.

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3. Requests for substitutions are only permitted for materials specified with an “or approved equivalent” clause or other language of the same effect in the Contract Documents.

B. The Horizontal Subsystem is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunications room. It consists of the telecommunications outlet/connector, the horizontal cable and the patch panel or termination block in the telecommunications room.

C. Cable Types
1. All telecommunications cables shall conform to ANSI/TIA 568-E Commercial Building Telecommunications Cabling Standard (latest amendment including all applicable addenda) and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard.
2. Be appropriate for the environment in which it is installed.
   a. All cables running below slab on grade shall be outdoor rated.
3. The copper 4-pair UTP CAT6A cables shall meet the following specifications:
   a. Attenuation
   b. Near End Crosstalk (NEXT)
   c. Power Sum Near Crosstalk (PSNEXT)
   d. Equal Level Far-End Crosstalk (ELFEXT)
   e. Power Sum Equal Level Far-End Crosstalk (PSELFEXT)
   f. Return Loss
   g. Propagation Delay (ANSI/TIA-568-E1)
   h. Delay Skew (ANSI/TIA-568-E1)
   i. Attenuation to Crosstalk Ratio (ACR)
   j. Power Sum Attenuation to Crosstalk Ratio (PSACR)
   k. Near End Crosstalk (NEXT) Loss
   l. Near End Crosstalk (NEXT) Loss
4. Cable shall be:
   a. Ortronics LANMark-10G2 Category 6A, Plenum, or approved equivalent
   b. Ortronics LANMark-XTP Category 6A, Riser or approved equivalent
   c. Ortronics LANMark—10G Category 6A, Indoor-Outdoor or approved equivalent
5. Equivalents shall:
   a. Meet or exceed parameters of the specified cable
   b. Be an approved Ortronics manufacturing partner
   c. Maintain warranty as stated herein

2.2 PATCH PANELS

A. Patch panels shall:
1. Support CAT6A performance levels.
2. Be angled to minimize or eliminate the use of horizontal cable managers to feed the patch panels.
3. Be 48-port capacity and 2RU in height.
4. Be 8-position /8-conductor with coherent pairing of IDC pins
5. Be backwards compatible to allow lowering the performing categories of cables or connecting hardware to operate to their full capacity.
6. Support industry standards for T568A or T568B wiring options on each individual outlet.
7. Be made by an ISO 9001 and 14001 Certified Manufacturer.
8. Be Ortronics, Part #OR-PHA66U48.

2.3 INFORMATION OUTLETS

A. All CAT6A high density information outlets for 100Ω 22-24AWG copper cable shall:
1. Be available in black, white, gray, ivory, light ivory, blue, and red.
2. Be 8-position /8-conductor with coherent pairing of IDC pins
3. Have available a 45-degree angled low profile as well as flush mount design.
4. Provide universal application/multi –vendor support

5. Utilize center tuned technology with optimized pair balance design and linear crosstalk response to address applications up to 500 MHz.
6. Support industry standards for T568A or T568B wiring options on each individual outlet.
7. Allow installation from the front or the rear of the faceplate and allow for the jack to pass through the faceplate without re-termination.
8. Be side-stackable for high density solutions.
9. Provide color-coded, slide-in icons available for circuit identification.
10. Be constructed of high impact, flame-retardant thermoplastic.
11. Be made by an ISO 9001 and 14001 Certified Manufacturer.
12. Be ANSI/TIA 568-2-E and ISO/IEC 11801 CAT6A compliant
13. Be UL VERIFIED (or equivalent) for TIA CAT6A electrical performance.
14. Be UL LISTED 1863 and CUL approved.
15. Be Ortronics, Part #OR-TJ600-78 (dark gray).

2.4 FACEPLATES

A. Face plates shall be:
1. Ortronics Stainless Steel, Part # OR-403STJ14 for single gang applications.
2. Ortronics Stainless Steel, Part # OR-403STJ28 for double gang applications.
3. Ortronics Stainless Steel, Part # OR-403STJ1WP for wall telephone applications.

B. Blank inserts shall be used in unused faceplate openings.
1. Ortronics, Part #OR-42100002-78 (dark gray).

PART 3 EXECUTION

3.1 SITE SURVEY

A. Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions shall not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

3.2 PHYSICAL INSTALLATION

A. Industry requirements: The following installation, documentation, component, and system industry specifications shall be met or exceeded:
1. ANSI/TIA-526-7-A “Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant”.
2. ANSI/TIA-526-14A “Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant”.
3. ANSI/TIA-568.1-E and addenda “Commercial Building Telecommunications Cabling Standard - General Requirements”.
4. ANSI/TIA-568.2-E and addenda “Commercial Building Telecommunications Cabling Standard - Balanced Twisted-Pair”.
5. ANSI/TIA-568.3-E and addenda “Commercial Building Telecommunications Cabling Standard - Optical Fiber Cabling and Components Standard”.
6. ANSI/TIA-568.4-E and addenda “Commercial Building Telecommunications Cabling Standard - Broadband Coaxial Cabling and Components Standard”.
7. ANSI/TIA-569-E and addenda “Commercial Building Standard for Telecommunications Pathways and Spaces”.
8. ANSI/TIA-606-D and addenda “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”.
9. TIA-607-E and addenda “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”.
10. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments “Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling”.

11. ISO/IEC 11801:2000 Ed1.2 and amendments “Information technology - Generic cabling for customer premises”.
12. CENELEC EN 50173:2000 and amendments “Information Technology - Generic cabling systems.”

B. Cable Pathways
1. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
2. Grounding and bonding of pathways shall comply with applicable codes and regulations.
3. Pathways shall not have exposed sharp edges that may come into contact with telecommunications cables.
4. The number of cables placed in a pathway shall not exceed manufacture specifications, nor shall the geometric shape of a cable be affected.

C. Cable Routing
1. All horizontal cables, regardless of media type, shall not exceed 90 meters (295 ft) from the telecommunications outlets in the work area to the horizontal cross-connect.
2. The combined length of jumpers or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10 meters (33 ft.) unless used in conjunction with a multi-user telecommunications outlet.
3. Two horizontal cables shall be routed to each work area. At least one cable connected to an information outlet shall be 4-pair, 100Ω unshielded twisted-pair (UTP).
4. Horizontal pathways shall be installed or selected such that minimum bend radius of horizontal cables is kept within the manufacturer’s specification both during and after the installation.
5. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5m (5ft) apart.
6. Telecommunications pathways, spaces, and metallic cables, which run parallel with electric power or lighting, which is less than or equal to 480 Vrms, shall be installed with a minimum clearance of 50mm (2in).
7. The installation of telecommunications cabling shall maintain a minimum clearance of 3m (10ft) from power cables in excess of 480 Vrms.
8. No telecommunications cross-connects shall be physically located within 6m (20ft) of electrical distribution panels, step down devices, or transformers, which carry voltages in excess of 480 Vrms.
9. For voice or data applications, 4-pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room serving that floor, to every individual information outlet.
10. The Contractor shall observe the bending radius and pulling strength requirements of the 4-pair UTP and fiber optic cable during handling and installation.
11. In the telecommunication room where cable trays or cable racking are used, the Contractor shall provide appropriate means of cable management such as reusable color-coded hook and loop.
12. In a false ceiling environment, a minimum of 9-inches shall be observed between the cable supports and the false ceiling.
13. Continuous conduit runs installed by the Contractor should not exceed 30.5m (100ft) or contain more than two (2) 90-degree bends without utilizing appropriately sized pull boxes.
14. Maximum conduit pathway capacity shall not exceed a 40% fill. However, perimeter fill is limited to 60% fill for move and changes.
15. Cables shall be bundled in groups of 24 cables maximum.

D. Work Area terminations:
1. All UTP cables wired to the telecommunications outlet/connector shall have 4-pairs terminated in eight-position modular outlets in the work area. All pairs shall be terminated.
2. The telecommunications outlet/connector shall be securely mounted at planned locations.
3. The height of the telecommunications faceplates shall be applicable to codes and regulations.

E. Pulling Tension
1. The maximum cable pulling tensions shall not exceed manufacturer’s specifications.

F. Bend Radius
1. The maximum cable bend radii shall not exceed manufacturer’s specifications.

2. In spaces with UTP cable terminations, the maximum bend radius for 4-pair cable shall not exceed four times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
3. During the actual installation, bend radius on 4-pair cable shall not exceed eight times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.

G. Slack/Service Loop
1. In telecommunications rooms a minimum of 6m (20ft) of slack should be left for all cable types. This slack must be neatly managed on plywood walls fields in locations as shown on drawings.

H. Cable Wraps
1. Hook and loop cable managers should be used in the telecommunications rooms where reconfiguration of cables and terminations may be frequent.

I. Grounding
1. Grounding and bonding shall be done per applicable codes and standards.

J. Cable Protection
1. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

K. Fire Protection
1. Properly installed firestop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, or raceways.
2. Fire stops shall comply with all applicable codes.

L. Workmanship
1. All work shall be done in a workman like fashion of the highest standards in the telecommunications industry. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed. Workers must clean any debris and trash at the close of each workday.

END OF SECTION 27 15 00

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SECTION 27 16 00 - COMMUNICATIONS CONNECTING CORDS, DEVICES, AND ADAPTERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

B. This section is inclusive to all Division 27 sections.

C. Division 7 Sections for fire-stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

1.2 DRAWINGS

A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.

B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

1.3 SCOPE OF WORK

A. General
1. This project includes the supply of patch cords, adaptors, and devices.
2. All UTP terminations must follow 568B wiring schematic.
3. Contractor shall install patch cords between switches and patch panels per Owner direction.

1.4 SUBMITTALS

A. The Contractor shall provide product submittals for all system components as defined in Part 2 of this specification section. These components shall include all communications connection cords, devices, and associated components. The selected Contractor shall allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant

PART 2 PRODUCTS

2.1 CORDS, DEVICES, AND ADAPTORS

A. This portion of the communications system includes termination of copper and fiber cables using modules and adaptors, faceplates, and patch cords.

2.2 WORK AREA

A. This section outlines specifications for the work area equipment cords, and telecommunications outlets at the user's work area. The connection between the information outlet and the device (computer/telephone) is achieved by means of this subsystem.

2.3 PATCH CORDS

A. Work Area patch cords shall meet or exceed the following criteria:
1. CAT6A, modular equipment cords shall:

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a. Be factory made.
b. Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.
c. Be equipped with modular 8-position (RJ45 style) plugs on both ends, wired straight through with standards compliant wiring.
d. Be backwards compatible with lower performing categories.
e. Use modular plugs which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications and have 50 micro inches minimum of gold plating over nickel contacts.
f. Be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants.
g. Be available in any custom length and standard lengths of 0.9, 1.5, 2.1, 3.1, 4.6, 6.1, 7.6 meters (3, 5, 7, 10, 14, 20, and 25 feet).
h. Be made by an ISO 9001 and 14001 Certified Manufacturer.
i. Electrical Specifications:
   1) Have a DC resistance per lead: 9.38 Ω / 100 m maximum.

   2) Have input impedance without averaging: 100 Ω + 15% from 1 to 100 MHz, + 22% from 100 to 200 MHz and + 32% from 200 to 250 MHz.

j. Be 100% transmission tested with laboratory grade network analyzers for proper performance up to 500 MHz. Vendor shall guarantee cords are compatible with CAT6A Permanent Link.
k. Be UL VERIFIED (or equivalent) for TIA CAT6A electrical performance.
l. Be UL LISTED 1863 and CUL C22.2 approved.
m. One plug end shall be of the Paralign type, and the other shall be low profile type to address bend radius requirements to plug into IP phones sets.
n. Be 15’ Length – White.
o. Supply one (1) per outlet of each faceplate plus 10%.

B. Telecommunication Room patch cords shall meet or exceed the following criteria:
1. CAT6A, modular equipment cords shall:
   a. Be factory made.
   b. Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.
   c. Be equipped with modular 8-position (RJ45 style) plugs on both ends, wired straight through with standards compliant wiring.
   d. Be backwards compatible with lower performing categories.
   e. Use modular plugs which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications and have 50 micro inches minimum of gold plating over nickel contacts.
   f. Be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants.
   g. Be available in any custom length and standard lengths of 0.9, 1.5, 2.1, 3.1, 4.6, 6.1, 7.6 meters (3, 5, 7, 10, 14, 20, and 25 feet).
   h. Be made by an ISO 9001 and 14001 Certified Manufacturer.
   i. Electrical Specifications:
      1) Have a DC resistance per lead: 9.38 Ω / 100 m maximum.

      2) Have input impedance without averaging: 100 Ω + 15% from 1 to 100 MHz, + 22% from 100 to 200 MHz and + 32% from 200 to 250 MHz.

   j. Be 100% transmission tested with laboratory grade network analyzers for proper performance up to 500 MHz. Vendor shall guarantee cords are compatible with CAT6A Permanent Link.
   k. Be UL VERIFIED (or equivalent) for TIA CAT6A electrical performance.
   l. Be UL LISTED 1863 and CUL C22.2 approved.
   m. Both plug ends shall be of the Paralign type, and have a protective mechanism to prevent connector from catching or obstructions
   n. Quantities shall be based on the total number of switch ports provided by the Owner, both active and inactive.
   o. Supply 25% of the cords 3’ Length – Blue.
   p. Supply 25% of the cords 5’ Length – Blue.
   q. Supply 25% of the cords 7’ Length – Blue.
   r. Supply 25% of the cords 9’ Length – Blue.

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2.4 REFERENCE PARTS

A. Ortronics #OR-VC615-09 Clarity VoIP Patch Cord – 15’ Length – White

B. Ortronics #OR-MC603-06 Clarity VoIP Patch Cord – 3’ Length – White

C. Ortronics #OR-MC605-06 Clarity VoIP Patch Cord – 5’ Length – White

D. Ortronics #OR-MC607-06 Clarity VoIP Patch Cord – 7’ Length – White

E. Ortronics #OR-MC609-06 Clarity VoIP Patch Cord – 9’ Length – White

PART 3 EXECUTION (NOT USED)

END OF SECTION 27 16 00

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SECTION 274000 – AUDIOVISUAL SYSTEMS BIDDING AND GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. Invitation: Van Buren Township invites Bids for a Single Prime Contract for the Audiovisual Systems for the The Lake House in Van Buren Township, Michigan.

B. Quotation Number: ####

C. Project Number:

1. Van Buren Township project number 2500281
2. NV5 Project number 6120825-0012082.00

D. Project name: Van Buren Township, The Lake House.

E. Project Substantial Completion Date and/or Schedule:

1. As indicated within the documentation accompanying this specification

1.2 INSTRUCTIONS TO BIDDERS

A. Definitions

1. Bidding Documents, includes the following:
   a. Bidding Requirements and Conditions of the Contract
   b. General Conditions
   c. Design and Performance Requirements
   d. Appendices
   e. Project Drawings
   f. Addenda (Issued prior to receipt of bids).
2. Bidder: Is a person or entity who submits a Bid.

B. Bidder Representation: Bidder, by submitting a Bid, represents that

1. Bidder has read and understands the Bidding Documents, and Bid is based upon equipment, materials, labor, training, documentation, and support as required by Bidding Documents without exception.
2. Bidder has attended Pre-Bid meeting, if mandatory.
3. Bidder has become familiar with local conditions under which the Work is to be performed within the requirements of the Bidding Documents.

C. Obtaining Bid Documents:

1. Bid Documents may be obtained via request to: bbarbaza@vbtmi.gov

D. Mandatory Pre-Bid Meeting:

1. As indicated within the documentation accompanying this specification.

E. Pre-Bid Request for Information:

1. As indicated within the documentation accompanying this specification.

F. Pre-Bid Substitutions

1. Where Bidding Documents refer to any items, materials, products and equipment by means of one or more manufacturer's trade name, catalog reference or similar means of

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identification of manufacturer and model, such reference establishes standard of required quality, appearance, dimension or function. It is not an intention of this specification to limit or restrict Bid Responses to those containing products by specific manufacturers, but rather to set a baseline of operational performance and functionality that all Bid Responses must meet or exceed.

a. Request shall include name of material, product or equipment to be substituted and a complete description of proposed substitution including drawings, performance and test data and other information necessary to demonstrate that the substitution will meet all intentions of this Specification or required for a complete evaluation.

b. Bidder shall assume and bear all responsibility for coordinating and performing related changes in the Work necessitated by such substitution and has included such costs in the Bid.

c. Burden of proof of merit of proposed substitution is upon Bidder.

2. Some manufacturer's names and product descriptions used in this specification are product specific with no substitutions allowed. These “Brand Specific” products are required to meet compatibility with the Owner’s existing systems and to maintain continuity of support. Refer to Appendix E for a listing of Brand Specific products.

3. All approved substitutions shall be communicated by Addenda. No Bidder shall rely upon approvals made in any other manner.

4. No substitutions will be considered after award of Contract, unless products listed in the specification have been discontinued or may not be available in time to meet the project schedule, or otherwise approved by Owner.

G. Exceptions: The Contractor shall notify the Consultant, prior to bid submission, of any and all exceptions to these specifications and related drawings. This shall include any errors or omissions in the system design and/or any inconsistencies or ambiguities between package documents that, in the Contractor’s opinion, may impact costs to the Owner or prevent the systems from achieving all purposes of the Specification.

H. Addenda:

1. Written or graphic instruments issued by Consultant prior to execution of Contract, which modify or interpret Bidding Documents by additions, deletions, clarifications or corrections. Addenda shall be binding and become part of Contract Documents.

2. Prior to receipt of Bids, Addenda will be issued to all recorded by Consultant as having received a complete set of Bidding Documents. Copies of Addenda will be available wherever Bidding Documents are on file for inspection.

3. Bidder is responsible to verify with Consultant that Bidder has received all addenda. Failure to receive such addenda shall not relieve Bidder from any obligation under his/her Bid as submitted.

4. Addenda issued after receipt of Bids will be delivered to the selected Bidder.

I. Subcontract Information: As part of the Bid Response, the Bidder shall indicate any portion of the project for which the Bidder intends to engage a Subcontractor. The Bidder shall further identify all responsibilities and all work to be performed by the Subcontractor. All work performed by the Subcontractor shall be under the supervision of the Contractor and shall be the responsibility of the Contractor.

J. Sales and Use Tax: The Bidder shall provide totals for all applicable state and local taxes where indicated on the bid form.

K. Preparation of Bids:

1. Bids shall be submitted on Bid Form included in Bid Documents.

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2. All blanks on Bid Form shall be filled in and executed with non-erasable ink product. Any alteration or erasure shall be initialed by the signer of Bid.
3. Bid Form shall state the legal name of Bidder and shall be signed by person or persons legally authorized to bind Bidder to a contract. Bid submitted by a corporation shall also give the state of incorporation and have corporate seal affixed. Bid submitted by an agent shall have a current power of attorney attached certifying agent's authority to bind Bidder.
4. The Bidder shall provide line item pricing for all equipment as an attachment. All pricing is to be inclusive of any applicable taxes, shipping, handling, expenses, insurance or other miscellaneous charges. The Bidder agrees that the Owner may increase, decrease, or delete entirely individual items, scheduled quantities of work to be done, or materials to be furnished after execution of the Contract.

L. Submission of Bids:
1. Submit Bid Form provided and with Bid Security and any other required documents enclosed.
2. Submit one (1) copy of all documentation.
3. Bidder is responsible for method and timely delivery to location designated for receiving of Bids.

M. Modifications or Withdrawal: Bidder may modify or withdraw his/her Bid at any time prior to bid receiving deadline by notice to Owner at place designated for receipt of Bids.
1. Notice shall be in writing and signed by authorized agent as indicated in original Bid Form.
2. Notice of modification or withdrawal of Bid is invalid if transmitted by automated electronic methods.

N. Bid Receiving:
1. As indicated within the documentation accompanying this specification.

O. Opening of Bids:
1. As indicated within the documentation accompanying this specification.

P. Rejection of Bids:
1. Bidder acknowledges right of Owner to reject any or all Bids, to waive any informalities or irregularities in Bids received and to re-advertise for Bid.
2. Bidder recognizes right of Owner to reject a Bid if Bidder failed to:
   a. Furnish any required Bid Security.
   b. Submit data required by Bidding Documents.
   c. Complete in any way the Bid Form.
   d. Attend the Pre-Bid meeting.

Q. Award of Contract: Intent of Owner is to award a Contract to low responsible Bidder. In determining low responsible Bidder, consideration will be given to following factors associated with the Bidder:
1. Ability, capacity and skill to comply with Specifications and perform the Work required by the Contract.
2. Character, integrity, reputation, judgment, experience and efficiency.
3. Ability to perform the Contract within time specified.
4. Quality of performance of previous Contracts.
5. Previous and existing compliance with laws relating to the Contract.

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6. Price bid for the Work.

R. Submission of Post Bid Information:

1. Upon notification by Owner, apparent low responsible Bidder shall submit within 5 days:
   a. Designation of the Work to be performed by Bidder with his/her own forces.
   b. List of names of subcontractors, other persons, organizations, or entities (include those who furnish materials or equipment fabricated to a special design) proposed for such portions of the Work designated in Bidding Documents or names of subcontractors proposed for principal portions of the Work.
   c. Bidder shall establish to the satisfaction of Consultant and Owner, reliability and responsibility of persons or entities proposed to furnish and perform the Work described in Bidding Documents.
   d. Prior to final determination of low responsible Bidder, Owner will notify apparent low Bidder in writing if, Owner has reasonable or substantial objection to and refuses to accept any person or firm on list. If Owner has objection, Bidder may withdraw Bid or submit a substitute with adjustment in cost to cover any difference. Owner shall accept adjusted Bid price or disqualify Bidder. In either condition, Bid Security shall not be forfeited.
2. Subcontractors, other persons, organizations, or entities proposed by Bidder and accepted by Owner must be used on the Work for which they were proposed and accepted, and shall not be changed except with written approval of Owner.

S. Post-Bid Interview: Upon receipt of Bid Responses, the Owner, Architect, and Consultant may require Bidders to participate in a Post-Bid Interview in Van Buren Township, Michigan. Bidders should be prepared to attend, answer questions, and clarify any discrepancies in Bid Responses.

1.3 BONDS

A. As indicated within the documentation accompanying this specification.

1.4 INSURANCE

A. As indicated within the documentation accompanying this specification.

1.5 PERMITS, FEES, AND LICENSING

A. As indicated within the documentation accompanying this specification.

1.6 START OF CONSTRUCTION

A. Work shall not begin until Contractor has received written Notice to Proceed.

1.7 SITE CONDITIONS

A. Conflicts: The Bidder shall be responsible for investigating any potential conflicts with site-related or union-related issues regarding use of personnel, scheduling, access to the site, storage of tools and equipment on-site, and other areas of potential conflict. If these issues impact the Bidder's Bid Response, the impacts on cost and schedule should be clearly noted in the Bid Response

B. Coordination: In the interest of a coordinated and professional project, the Contractor shall:

1. Coordinate his/her work with that of other trades. The Contractor should anticipate attending weekly project coordination meetings with the Owner, Architect, General Contractor, Consultant or other trades as required.
2. Afford other trades reasonable opportunity for installation work and for storage of materials.

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3. Staff the job to keep pace with other Trades.

C. Equipment Delivery and Storage: Costs of all shipping to the site, and of all unusual storage requirements, shall be borne by the Contractor. It shall be the responsibility of the Contractor to make appropriate arrangements, and to coordinate with the authorized personnel at the site, for the proper acceptance, handling, protections, and storage of equipment so delivered.

D. Refuse / Cleaning Up:

1. The Contractor shall keep the site and building free of all debris and clutter, to the satisfaction of the Owner or site manager. On a daily basis, the Contractor shall remove refuse and rubbish related to the specified work from the site and shall leave the relevant areas and equipment clean and in an operational state. The Contractor shall be responsible for repairing any damage caused to the premises by the Contractor’s installation activities, at no cost to the Owner.

2. At completion of the Work, the Contractor shall remove from and about the Project waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.

3. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

E. Use of Site:

1. Contractor shall adhere to the Owner's instructions regarding non-smoking, noise, signs, advertisements, and fires.

2. The Contractor shall confine operations at the site to areas permitted by the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

F. Cutting and Patching:

1. The Contractor shall be responsible for cutting, fitting or patching as required to complete the Work or to make its parts fit together properly.

2. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

G. Access to Work: The Contractor shall provide the Owner and Consultant access to the Work in preparation and progress wherever located.

1.8 POST-AWARD REQUEST FOR INFORMATION

A. All requests for information (RFIs) shall be communicated by way of the enclosed Request For Information Form (APPENDIX D). RFI forms may be e-mailed to the Consultant at Justin.Gurevitch@NV5.com.

B. All RFIs shall identify the issue and provide a proposed solution. The proposed solution shall include any potential impact to cost and/or schedule. Proposed solutions will be reviewed and approved by the Owner, Architect and/or Consultant, or alternate solutions will be recommended.

C. The Contractor shall receive written response within 5 working days of receipt of the RFI by the Owner/Consultant.

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1.9 PROTECTION OF PERSONS AND PROPERTY

A. Safety Precautions and Programs: The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. This requirement applies continuously 24 hours per day during construction of the Project.

B. Safety of Persons and Property: The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

1. employees on the Work and other persons who may be affected thereby;
2. The Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors and vendors.

C. Weapons Policy: Possession of dangerous weapons (concealed or unconcealed) on the Owner’s property, on the work site, in Owner vehicles, or in personal vehicles when on the Owner’s property shall be a violation of the Owner’s policy. A dangerous weapon shall include guns, knives, explosives, or any other device as determined by the Owner, which in the manner used or intended is capable of producing death or bodily injury. Devices authorized by the Owner and/or provided to its employees for the purpose of carrying out work responsibilities shall not be deemed dangerous weapons for the purpose of this policy. Violations of this policy shall make the offender subject to appropriate disciplinary action.

1.10 OFF-SITE STORED MATERIALS

A. Summary: This Section specifies administrative and procedural requirements for handling requests for approval of partial payments for certain materials stored off-site.

B. Prior Approval: Contractor shall obtain Owner's approval before making any arrangements to obtain a Certificate for Payment for Materials stored off-site. Materials shall be suitable for storage and be properly packaged as necessary.

C. Storage Site: Contractor shall furnish and maintain a suitable storage site, approved in advance by Owner.

D. Storage Conditions:

1. Material shall be stored above grade, properly protected at all times against weather, hot, cold, moisture, and other hazards as material may require. All protection shall be provided by Contractor, at his/her own expense, and maintained throughout storage period.
2. Material shall not be commingled with other similar material, but be stored by itself and plainly labeled: "Property of Van Buren Township”.

E. Bill of Sale:

1. Request for Certification for Partial Payment for materials stored off-site under approved conditions shall be accompanied by a Bill of Sale, properly identifying material and transferring ownership of materials to Owner.
2. Bill of Sale shall be accompanied with:
   a. Inventory of stored material.
   b. Description of storage site by street number and city, or by a legal description of the premises.

F. Insurance: Contractor shall take out and maintain fire, all perils, theft, vandalism and extended coverage insurance on off-site stored material and in-transit materials, in amount of 100% of value thereof, under same conditions as for material stored on site of the project. Owner shall be named beneficiary under the policy, as trustee for all concerned.

G. Responsibility:

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1. Contractor agrees that, in accepting partial payment for off-site stored materials, they are in no way relieved of responsibility for safe storage of material and its safe transportation to, and installation in, the Work, or for furnishing and installing materials in strict accordance with Contract Documents.
2. Contractor agrees that acceptance by Owner of a Bill of Sale for Material does not imply acceptance or rejection up until time Contractor's work is completed and finally accepted.
3. Contractor agrees that usual guarantees covering his/her work under Contract Documents are in no way impaired as a result of partial payment and acceptance of the Bill of Sale.

1.11 DELAY IN COMPLETION AGREEMENT

A. The Owner and the Contractor agree that it would be impossible to accurately fix the actual damages sustained by the Owner due to the Contractor's failure to place the systems into service by the Substantial Completion Date or as otherwise amended by mutual agreement of the parties. Therefore, in the event that the systems are not substantially installed and available for use by such Substantial Completion Date, liquidated damages of Five Hundred Dollars ($500) per day shall be owed by the Contractor to the Owner for each day of delay caused solely by the Contractor, excluding any delay caused by the Owner, or an event beyond the Contractor's control.

1.12 LIMITATION OF LIABILITY

A. The Contractor's entire liability under the Delay In Completion Agreement, including liability arising out of the Products purchased or services performed shall be limited to the total value of the Agreement. Regardless of the legal or equitable basis of any claim or of actual notice, neither the Contractor nor the Contractor's suppliers shall be liable for indirect, special, consequential, or incidental damages. Any claim by the Owner shall be brought within one year of the date of the circumstance of event giving rise to the claim. If the Contractor's performance under this Agreement, or of any obligation here under, is interfered with by reason of any circumstances beyond the Contractor's reasonable control, including, without limitation, fire, explosion, power failure, acts of God, war, revolution, civil commotion, or acts of public enemies, any law, order, regulation, ordinance, or requirement of any government or legal body or any representative of any government or legal body; labor unrest, including, without limitation, strikes, slowdowns, picketing or boycotts; then the, Contractor shall be excused from its performance on a day-for-day basis to the extent of such interference.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 274000

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SECTION 274116 – INTEGRATED AUDIOVISUAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 PROJECT OVERVIEW

A. Van Buren Township is currently constructing the new The Lake House community center in Michigan. The new facility will include audiovisual enabled collaboration spaces supporting community events and meetings. Spaces in the building include a divisible ballroom, multipurpose space, and meeting room all of which shall include audiovisual technologies.

B. Van Buren Township is seeking a turn-key job to be provided by one vendor to supply equipment, labor, installation materials, control systems programming, audio DSP programming, testing, training, and follow-up support for the audiovisual systems as described in this Specification.

1.2 GENERAL FOR ALL SYSTEMS

A. The following are applicable to all systems unless noted otherwise.

1. System type (i.e. SY01) refers to a system signal flow for a particular space/system. X / AVSXX indicates the sheet and the detail that the system can be found within the signal flow drawings.

2. Control System

a. The audiovisual control system touch panel or push-button panel associated with each system shall provide control of components within the audiovisual system. Control requirements are dependent upon the functionality of the space. Control may include, but is not limited to, the following capabilities:

1) Power the system on/off

2) Control of source device selection

3) Control of video routing to displays and other devices

a) The last video source routed to a display will be the audio source utilized within the space. Coordinate final configuration with the Owner.

b) On touch-panel control systems, this includes secure technician level access to configure or reconfigure default routing.

c) The Contractor shall develop an easy to use interface on the touch panel that provides control of the routing assignments of the instructor's source content to all or select displays within the space.

4) Control of audio including volume up/down/mute

a) On touch-panel control systems, this includes secure technician level access to controllable aspects to the audiovisual system's DSP settings if applicable.

5) Control room lighting by recalling presets within the lighting control system provided by others.

a) Coordinate with the Architect regarding spaces that will include this capability

6) Include a button to reset the system to its default video routes and audio levels without having to shut down and restart the system. This is for spaces with touch panel control only.

b. Any other operations that the control system can control not explicitly noted.

c. See Section 3.2 Control System Software Design & Development for further requirements.

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d. If required, a utilities section within the user interface shall provide any user with control of additional parameters of the audiovisual system that may not need to be accessed on a regular basis.

e. All audiovisual control systems shall include secondary analogous control of the audiovisual system. This shall be enabled through an app and/or web interface on an Owner-provided tablet or other mobile device. See Section 3.2 Control System Software Design & Development for further requirements.

3. Connections to network outlets located outside of a rack mounted patch panel shall utilize patch cables that match the Owner's patch cable requirements for connection to the facility LAN. Reference Division 27 Communications specifications.

4. The Contractor shall coordinate with the Architect and/or Owner on the color and/or finish of the touch panel, push-button panel, flip-top control system, flip-top cable enclosure, exposed equipment racks, equipment rack cabinets, instructor stations, credenzas, loudspeakers and ceiling-mounted microphones.

5. The Contractor shall coordinate the cut-outs with the furniture supplier/Architect/Owner on the location of the flip-top cable enclosures, touch panel controllers, microphones, or any other ancillary audiovisual devices that may be located on the surface of a table, instructor's station, or presentation station. This applies to all Contractor supplied furniture or furniture supplied by others that requires integration of audiovisual components. See Scope of Work and Installation Practices for further requirements.

6. Any cables connected to a floor or wall box shall be wrapped in a flexible sheath and shall be color coded. Coordinate colors with the Owner.

7. The Contractor shall coordinate the length of any premade cable assemblies.

8. The Contractor shall provide wire-ties, hooks, raceway or cable channels as necessary within Owner provided furniture to ensure a complete and neat installation. For example, cables shall not be seen hanging or draped under a table.

9. The Contractor shall provide mounts or mounting solutions unless specified to be by others. Examples include wall or ceiling mounted flat panel displays, ceiling or wall mounted video projectors, and devices which are located behind flat panel displays, under tables, within plenum boxes or other locations that may house audiovisual equipment within the audiovisual system.

10. All instructor's stations, credenzas, and equipment racks provided by the Contractor shall all have locking doors to limit access. All locks shall be keyed identically. Coordinate requirements with the Owner.

11. Manufacturer Assistance

    a. The Contractor shall utilize any manufacturer assistance for programming, configuring or commissioning any of the systems within the facility as required to provide fully functional systems as indicated within this specification.

1.3 SYSTEMS DESCRIPTIONS

A. SY01 (1/AVS01) – Ballroom, Quantity 1 (Room Numbers 169 / 170 / 164). The ballroom is a two-way divisible space that shall support audiovisual presentations, special events, sound reinforcement, assistive listening, and software-based web conferencing. Each divisible section shall be capable of operating independently, and the complete Ballroom shall be capable of operating as a combined system. Video signals shall be distributed using an AVoIP system. The system shall include the following:

1. Display System

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a. Contractor shall provide two large-format ceiling-mounted laser video projectors, complete with appropriate lenses, ceiling mounts, extension columns, mounting hardware, and associated accessories.
b. Projection screens and screen cases shall be OFOI.
    1) Contractor shall coordinate projector locations, lenses, control, and interfaces with the projection screens shown on the infrastructure drawings.
c. Contractor shall provide two 55-inch flat-panel confidence displays, each furnished with a mobile cart and required mounting hardware.
    1) In divided mode, each confidence display shall default to the presentation content associated with its respective Ballroom section.
    2) In combined mode, the confidence displays shall present the selected system content as directed through the audiovisual control system.

2. Source Devices
    a. Contractor shall provide one wireless presentation device with Miracast capability for each divisible section.
    b. Contractor shall provide one HDMI and USB-C input connection for each divisible section. Input connections shall be located at the associated floor box and extended to the AV equipment rack.
    c. Contractor shall provide AVoIP encoders and decoders as required to route audiovisual sources to the projectors, confidence displays, USB AV bridges, and other system destinations.
    d. Contractor shall provide one digital signage player connected to the AVoIP system and Owner's building network.
    e. Owner-furnished computers and portable source devices may be connected to the system through the HDMI, USB-C, USB, and network interfaces indicated on the drawings.
3. Video Capture / Web Conferencing
    a. Contractor shall provide two rear-wall-mounted PTZ cameras, one serving each divisible section. Cameras shall include the required camera extension receivers and shall be integrated with the AVoIP system.
    b. Contractor shall provide one USB AV scaling bridge for each divisible section to support software-based web conferencing using a future Owner-furnished computer.
    c. Each USB AV bridge shall provide selected camera video and system audio to the connected Owner-furnished computer.
        1) In divided mode, each section's rear-wall camera and associated audio shall default to that section's USB AV bridge.
        2) In combined mode, the user shall be able to select the camera routed to the USB AV bridge through the audiovisual control system.
    d. Far-end audio received from an Owner-provided computer shall be routed through the system audio processor and reinforced over the appropriate Ballroom loudspeaker zones.
    e. The system shall provide acoustic echo cancellation and USB audio interfacing to support web-conferencing applications running on Owner-provided computers.
4. Audio
    a. Contractor shall provide a distributed ceiling loudspeaker system consisting of ceiling loudspeakers arranged in four independently addressable zones.
    b. Contractor shall provide a four-channel amplifier with Dante connectivity and integrated digital signal processing to power the ceiling loudspeaker system.

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c. Contractor shall provide a digital audio processor with Dante, USB audio, acoustic echo cancellation, audio mixing, routing, and room-combining capabilities.
d. Contractor shall provide a four-channel digital wireless microphone system consisting of:
    1) Two wireless bodypack transmitters with lavalier microphones.
    2) Two wireless handheld microphones.
    3) Antenna distribution and remote antennas as required.
    4) Rechargeable batteries and an eight-bay rack-mounted battery charger.
e. The system shall route microphone, program, conferencing, and other audio signals to the appropriate loudspeaker zones based on the selected room-combining mode.
    1) In combined mode, audio shall be capable of being distributed throughout the Ballroom.
    2) In divided mode, each section's audio shall default to the loudspeaker zones serving that section.
f. Contractor shall provide a two-channel, Dante-enabled Wi-Fi assistive listening system, including seven portable receivers with ear speakers, two neck loops, a docking/charging station, required rack-mounting accessories, and assistive listening signage.
    1) Assistive listening channels shall be configured to support the programmed combined and divided operating modes.

5. Control
    a. Contractor shall provide an integrated audiovisual control system for control of room-combining functions, source selection, source routing, projector lift, projector, and screen operation, confidence displays, audio functions, microphone levels, camera selection, camera presets, and conferencing functions.
    b. Contractor shall provide two wall-mounted touch panels, one serving each divisible section.
    c. Contractor shall provide two tabletop touch panels, one associated with each presenter's lectern.
    d. Contractor shall provide a partition sensor which will automatically switch the system into either divided or combined mode based on the status of the partition.
    e. In divided mode, each section's touch panels shall control the audiovisual equipment and functions associated with that section.
    f. In combined mode, the touch panels shall provide coordinated control of the combined Ballroom system.
    g. Contractor shall provide technician-level control pages for system configuration, source routing, audio adjustment, camera control, and system diagnostics. Access to technician-level functions shall be password- or passcode-protected.
    h. Contractor shall coordinate room-combining control logic with the operable partition status and the Owner's operational requirements.

6. Hardware
    a. Contractor shall provide two mobile presenter's lecterns, one for each divisible section. Each lectern shall include AV connectivity, a flip-up shelf, cable management, and provisions for the associated tabletop touch panel and Owner-furnished equipment.
    b. Each lectern shall connect to the associated custom floor box connection plate using prefabricated tactical cabling.
    c. Contractor shall provide one full-height AV equipment rack located in Room 164. The rack shall house the centralized AVoIP, audio processing, amplification, wireless microphone, assistive listening, control, and related equipment.
    d. Contractor shall provide rack power distribution, rack identification panels, shelves, blank panels, ventilation accessories, cable management, mounting hardware, power supplies,

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patch cords, terminations, and other incidental materials required for a complete and operational system.

e. Contractor shall provide one managed AVoIP network switch with PoE and Dante support in the AV equipment rack. Contractor shall coordinate connections to the Owner's building network where indicated.

f. Computers and other Owner-furnished equipment shall be furnished by the Owner and installed or connected by the Contractor where indicated.

B. SY02 (1/AVS02) – Community Living Room / Multi-Purpose Room, Quantity 1 (Room Numbers 104 / 105). The Community Living Room / Multi-Purpose Room is a divisible space that shall support audiovisual presentations, special events, sound reinforcement, assistive listening, and software-based web conferencing. Each room within this system shall function independently with the capability of the Community Living Room being used as overflow or as part of the Multi-Purpose Room. Video signals shall be distributed using an AVoIP system. The system shall include the following:

1. Display System
   a. Contractor shall provide three flat panel displays, complete with appropriate mounts, mounting hardware, and associated accessories.
2. Source Devices
   a. Contractor shall provide one wireless presentation device with Miracast capability for each room.
   b. Contractor shall provide one HDMI and USB-C input connection for room.
      1) For the Multi-Purpose Room (105), input connections shall be located at the associated credenza in a cable enclosure on the credenza top.
   c. Contractor shall provide AVoIP encoders and decoders as required to route audiovisual sources to the displays, USB AV bridges, and other system destinations.
   d. Owner-furnished computers and portable source devices may be connected to the system through the HDMI, USB-C, USB, and network interfaces indicated on the drawings.
3. Video Capture / Web Conferencing
   a. Contractor shall provide two wall-mounted PTZ cameras, each serving the Multi-Purpose Room. Cameras shall include the required camera extension receivers and shall be integrated with the AVoIP system.
   b. Contractor shall provide one USB AV scaling bridge to support software-based web conferencing using a future Owner-furnished computer in the Multi-Purpose Room.
   c. USB AV bridge shall provide selected camera video and system audio to the connected Owner-furnished computer.
   d. Far-end audio received from an Owner-provided computer shall be routed through the system audio processor and reinforced over the appropriate Ballroom loudspeaker zones.
   e. The system shall provide acoustic echo cancellation and USB audio interfacing to support web-conferencing applications running on Owner-provided computers.
4. Audio
   a. Contractor shall provide a distributed ceiling loudspeaker system consisting of ceiling loudspeakers arranged in three independently addressable zones.
   b. Contractor shall provide a four-channel amplifier with Dante connectivity and integrated digital signal processing to power the ceiling loudspeaker system.
   c. Contractor shall provide a digital audio processor with Dante, USB audio, acoustic echo cancellation, audio mixing, routing, and room-combining capabilities.

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d. Contractor shall provide a four-channel digital wireless microphone system consisting of:
   1) One wireless bodypack transmitter with lavalier microphone.
   2) One wireless handheld microphone.
   3) Antenna distribution and remote antennas as required.
   4) Rechargeable batteries and an eight-bay rack-mounted battery charger.
e. The system shall route microphone, program, conferencing, and other audio signals to the appropriate loudspeaker zones.
f. Contractor shall provide a two-channel, Dante-enabled Wi-Fi assistive listening system, including seven portable receivers with ear speakers, two neck loops, a docking/charging station, required rack-mounting accessories, and assistive listening signage.
   1) Assistive listening channels shall be configured to support the programmed combined and divided operating modes.

5. Control
   a. Contractor shall provide an integrated audiovisual control system for control of room-combining functions, source selection, source routing, and display operation, audio functions, microphone levels, camera selection, camera presets, and conferencing functions.
   b. Contractor shall provide one wall-mounted touch panel in the Community Living Room (104). This shall control the capabilities of the Community Living Room only.
   c. Contractor shall provide one tabletop touch panel at the credenza in the Multi-Purpose Room.
   d. Contractor shall provide a partition sensor which will automatically switch the system into either divided or combined mode based on the status of the partition.
   e. In divided mode, each section’s touch panels shall control the audiovisual equipment and functions associated with that section.
   f. In combined mode, the touch panels shall provide coordinated control of the combined Community Living Room / Multi-Purpose Room system.
   g. While the Community Living Room is in overflow mode, the wall-mounted touch panel shall provide the ability to control volume levels and turning off overflow mode only.
   h. Contractor shall provide technician-level control pages for system configuration, source routing, audio adjustment, camera control, and system diagnostics. Access to technician-level functions shall be password- or passcode-protected.

6. Hardware
   a. Contractor shall provide an AV credenza. The credenza shall include AV connectivity, cable management, and provisions for the associated tabletop touch panel and Owner-furnished equipment.
      1) The credenza shall house the centralized AVoIP, audio processing, amplification, wireless microphone, assistive listening, control, and related equipment.
   b. The credenza shall connect to the associated custom wall box plate using prefabricated tactical cabling.
      1) Contractor shall provide a minimum of 10’ length of cable slack at the credenza, allowing the user some room for future maintenance.
   c. Contractor shall provide rack power distribution, rack identification panels, shelves, blank panels, ventilation accessories, cable management, mounting hardware, power supplies, patch cords, terminations, and other incidental materials required for a complete and operational system.
   d. Contractor shall provide one managed AVoIP network switch with PoE and Dante support in the credenza. Contractor shall coordinate connections to the Owner’s building network where indicated.

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e. Computers and other Owner-furnished equipment shall be furnished by the Owner and installed or connected by the Contractor where indicated.

C. SY03 (2/AVS02) – Meeting Room, Quantity 1 (Room Number 118). The Meeting Room is a space that shall support audiovisual presentations, and software-based web conferencing. Video signals shall be distributed using an HDBaseT signal transport system. The system shall include the following:

1. Display System
   a. Contractor shall provide one flat panel display, complete with appropriate mounts, mounting hardware, and associated accessories.
2. Source Devices
   a. Contractor shall provide one wireless presentation device with Miracast capability.
   b. Contractor shall provide one HDMI and USB-C input connection for room.
   c. Contractor shall provide HDBaseT transmitters and receivers as required to route audiovisual sources to the display, web conferencing soundbar, and other system destinations.
   d. Owner-furnished computers and portable source devices may be connected to the system through the HDMI, USB-C, USB, and network interfaces indicated on the drawings.
3. Web Conferencing
   a. Contractor shall provide a web conferencing soundbar along with any required mounting solutions.
   b. The system shall provide acoustic echo cancellation and USB audio interfacing to support web-conferencing applications running on Owner-provided computers.
4. Audio
   a. Contractor shall provide a web conferencing soundbar that will handle all program and far-end audio.
5. Control
   a. Contractor shall provide an integrated audiovisual control system for control of source selection, source routing, display operation, audio functions, camera presets, and conferencing functions.
   b. Contractor shall provide one tabletop touch panel.
   c. Contractor shall provide technician-level control pages for system configuration, source routing, audio adjustment, camera control, and system diagnostics. Access to technician-level functions shall be password- or passcode-protected.
6. Hardware
   a. Contractor shall provide any and all required mounting accessories to locate AV equipment as indicated on the drawings.
   b. Contractor shall provide power distribution, ventilation accessories, cable management, mounting hardware, power supplies, patch cords, terminations, and other incidental materials required for a complete and operational system.
   c. Computers and other Owner-furnished equipment shall be furnished by the Owner and installed or connected by the Contractor where indicated.

D. SY04 (1/AVS03) – Outdoor Sound System, Quantity 1. The Outdoor Sound System is a system that shall support distribution of audio sources outside of both the Ballroom as well as the Community Living Room / Multi-Purpose room spaces. Audio signals shall be distributed using a Dante signal transport system. The system shall include the following:

1. Audio

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a. Contractor shall provide an outdoor distributed wall-mounted loudspeaker system consisting of loudspeakers arranged in five independently addressable zones.
b. Contractor shall provide an eight-channel amplifier with Dante connectivity and integrated digital signal processing to power the loudspeakers.
c. The digital audio processor associated with system SY01 shall provide the capability to use Dante, USB audio, acoustic echo cancellation, audio mixing, routing, and zone-combining capabilities.
d. The system shall route microphone, program, conferencing, and other audio signals to the appropriate loudspeaker zones.
    1) The default input for the system shall be an OFCI digital media player.

2. Control
    a. Contractor shall provide one tabletop touch panel.
    b. Control of the system shall be achieved via the control system processor associated with SY01 and the contractor provided touch panel referenced above.

3. Hardware
    a. Contractor shall install all rack mounted equipment in the AV equipment rack associated with SY01.

1.4 CONTRACTOR QUALIFICATION REQUIREMENTS:

A. Bidder shall submit with the bid response evidence of his/her qualifications to perform the work specified. Contractor qualifications shall be the most current information available but not more than one year old. Submit one copy of documentation to both Owner and Consultant for review and approval. All contractor qualifications shall be communicated by way of the enclosed Contractor Qualification Requirements Form (APPENDIX C), and shall include the information listed below.

1. Corporate Profile
    a. Location of Corporate Headquarters
    b. Number of offices and locations
    c. Location of office assigned to this project
    d. Corporate History
        1) How Many years in this business?
        2) Under what former names has your organization operated
        3) Date(s) of incorporation
        4) State of incorporation
        5) Officers names and addresses
    e. Litigation Experiences Within the Last 5 Years
        1) Project Related:
            a) Nature of Litigation
            b) Plaintiff or Defendant
            c) Outcome
        2) Non-Project Related
            a) Nature of Litigation
            b) Plaintiff or Defendant
            c) Outcome

2. Financial
        1) Trade and Bank Credit References (List 3)

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2) Dunn & Bradstreet ranking
3) Insurance Limits
4) Name of Bonding Company
5) Name and address of Agent
6) Maximum Bonding Capacity
7) Current Bonding Capacity
8) Performance Bond ever exercised?

3. Staffing
   a. Number and Type of Full-Time Staff
      1) Total number of employees
      2) Number of design staff
      3) Number of installation staff
      4) Number of project management staff
      5) Number of software programming staff
   b. Identify key personnel that will be assigned to this project including:
      1) Project Executive
      2) Project Manager
      3) Systems Engineer/Designer
      4) Lead Installer/Crew Chief/Superintendent/Lead Technician
      5) Control Systems Programmer
      6) Audio DSP Programmer
      7) Commissioning Agent
      8) Trainer
   c. For each Individual listed above provide a resume that includes:
      1) Office Location
      2) Percentage of individual's time that will be allocated to this project
      3) Work History
      4) Previous Project Experience:
         a) The assigned Project Manager shall have a minimum of five (5) years' experience in the fabrication, assembly, and installation of audiovisual systems of similar magnitude and quality to that indicated for this project.
         b) The assigned Systems Engineer/Designer shall have a minimum of five (5) years' experience in the fabrication, assembly, and installation of audiovisual systems of similar magnitude and quality to that indicated for this project.
      5) Length of Employment
      6) Certifications: CTS, CTS-D, CTS-I, EST-L2, RCDD, PMP, Certified Control System Programmer, Certified DSP Programmer, CompTIA Network+, CCNA, other.
      11) The project will utilize NAV products by Extron. The Contractor's Systems Engineer/Designer shall hold a current Extron Network AV Specialist certification. The Bidder shall submit the name of the Systems Engineer/Designer, certification expiration date and certification number.
      12) The Contractor's Lead Installer shall hold a current CTS-I (Certified Technology Specialist – Installation) certification from AVIXA/InfoComm International. The Bidder shall submit the name of the lead installer and certification expiration dates.

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16) The project will utilize NAV products by Extron. The Contractor's Lead Installer shall hold a current Extron Network AV Specialist certification. The Bidder shall submit the name of the Lead Installer, certification expiration date and certification number.

21) The project will utilize control system products by Extron Electronics. Due to the potential complexity of the control system, an Extron Certified Control Specialist(s) with active certification shall be required to author the programming component of this project. The Bidder shall provide documentation listing project team member(s) who will create the control system programming including a listing of years of experience, a statement of manufacturer authorization, certification type, date of certification and the certificate number.

25) Due to the potential complexity of the Audio DSP system, a QSC Q-SYS Level Two Training certified individual, with active certification(s), shall be required to author the programming for the Audio DSP component of this project. The Bidder shall provide documentation listing project team member(s) who will program the Audio DSP including a listing of years of experience, a statement of manufacturer authorization, certification type and date of certification. In addition to the DSP certifications, the bidder shall provide any audio supportive certifications of merit (i.e. Syn-Aud-Con and AVIXA/InfoComm certifications relevant to audio training and/or CompTia and Cisco certifications relevant to network training).

4. Resources
   a. A manufacturers' line card for products in which the Bidder is an authorized Distributor or Dealer. Include date initially authorized.
   b. A list of any manufacturers' specialized technical certifications or designations held by the Bidder.
   c. A list of manufacturers for whom the Bidder is an authorized service center.
   d. A list of computer software and/or systems owned by the Bidder, which will be used to communicate, measure, draw, and/or document the project.
   e. A list of system test equipment owned and used by the Bidder, including manufacturer, model number and, where applicable, latest software revision.
5. References
   a. Include three project references, including:
      1) Contact name
      2) Institution name
      3) Phone number
      4) E-mail address
   b. Include three projects of:
      1) Similar scope and scale.
      2) Similar technology applications
      3) Provide Project cost for each
   c. List any past projects where Bidder has worked with the Owner, Consultant, Architects, or Construction Manager who are part of this project team.

1.5 GENERAL CONDITIONS

A. The General Conditions, Requirements, and Special Provisions, of any larger body of specifications, of which this Specification may be a part, are hereby made a part of this Specification. In the event that any clauses or provisions of the larger body of specification conflict with the letter or intent of this Specification, the Contractor shall immediately notify the Consultant for clarification and direction.

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1.6 THE SPECIFICATION

A. The “Specification” is defined as the body of documentation provided to the Contractor with the Request for Quotation, as well as all addenda to said documentation. Throughout this document, words such as “herein” refer to the entire Specification, and not just this written document.

B. The Specification includes, but is not limited to:

1. This written specification document.
2. All drawings, as listed in the List of Drawings.
3. Additions and/or modifications as detailed in written addenda.
4. Additions and/or modifications as detailed in drawing additions or reissues.

C. The purpose of the Specification is to provide sufficient detail for the Bidder to understand the functional requirements of the systems, the installation and performance standards that must be met, and the required scope of work, in order to generate and submit a complete and accurate bid.

1.7 DEFINITION OF TERMS

A. Within this section of the specification, the following definitions shall apply:

1. The term “Owner” is used to indicate Van Buren Township.
2. The term “Architect” is used to indicate Fishbeck.
3. The term “Consultant” is used to indicate: NV5. 1501 Reedsdale Street, Suite 300, Pittsburgh, PA, 15233.
4. The term “Bidder” is used to indicate that entity generating the bid response.
5. The term “Contractor” is used to indicate the successful Bidder to whom the Owner has awarded the contract.
6. The term “Furnish” is used to indicate the responsibility to procure and ship or deliver the item to the job site, freight prepaid, for receipt, staging and installation by others.
7. The term “Install” or “Installation” is used to indicate the responsibility of receiving the item at the job site, assuring adequate storage, unpacking or uncrating the item, physically securing the item, configuring and testing the item, or otherwise making ready the item for its intended use by following the instructions and approved methods of the manufacturer and any additional requirements described herein.
8. The term “Provide” is used to indicate the responsibility to both “Furnish” and “Install.”
9. The term “Provided by Others” shall refer to material and work, which is related to this contract, but has been provided by parties other than the AV Contractor. An example might be in reference to a projection screen installed during building construction but requiring interface to the AV control system.
10. The terms “NIC” and “Not In Contract” are equivalent to “Provided by Others.”
11. The term “OFCI” (Other Furnished Contractor Installed) shall refer to equipment that will be furnished by the Owner or others for installation by the Contractor. The Contractor shall be responsible for coordinating with the Owner regarding the specific requirements of the equipment as applicable to meet the functional requirements of the systems as specified. The Contractor shall be responsible for installing and integrating this equipment as required to produce a fully functioning system. This may include the installation and configuration of software, PCI cards or other components within or attached to OFCI computers that are required by the AV systems.

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12. The term “Contractor Selected” refers to ancillary items where no specific manufacturer and/or model number has been listed as the basis of design in the Bidding Equipment List. The Contractor shall select a product that meets the performance and functional requirements of the system and submit the product as part of the line item pricing, Shop Drawings and Bill of Materials submittal process as defined herein.
13. The term “Installation Materials” shall reference installed cable, loose cable, terminations, signal extenders, cable management, voice/data/video patch cords, adapters, I/O panels, cable dressing, lacing bars, copper bus bars, labels, rack shelves, rack mounts, power supplies and adapters, power strips/distribution and other materials as needed to install the systems defined herein.
14. The term “Substantial Completion” is used to indicate the stage in the progress of the work where the systems are determined to be sufficiently complete in accordance with the Specification so that the Owner can utilize the systems for their intended use.
15. The term “Final Acceptance” is used to indicate the point in which all contract requirements have been met by the Contractor after Substantial Completion has been achieved. This includes, but is not limited to, the correction and acceptance of any remaining punch-list items, approval and delivery of all Final Documents, and user training as specified.
16. The term “shall” is mandatory; the term “will” is informative; and the term “should” is advisory.

1.8 SCOPE OF WORK

A. The Contractor shall provide complete, turnkey audiovisual systems performing all of the services and functions as described herein, together with all other apparatus, cable, materials, labor, tools, transportation, and any other resources necessary to provide a complete system.

B. Specifically, the work shall include, but is not limited to:

1. Coordination
   a. Communicating and coordinating directly with the Consultant, Owner, Architect and other trades complying with all requirements as defined under this Scope of Work and elsewhere, to fulfill all requirements of this specification.
   b. Scheduling installation operations in sequence required in order to obtain best completion results.
   c. Coordinating installation of different components to assure maximum accessibility for required maintenance, service, and repair.
   d. Verifying required cable lengths for all bulk cable or manufactured cable assemblies prior to ordering as outlined in ‘Installation Practices’.
   e. Verifying the accuracy of Master Quote or other quotation numbers prior to ordering.
      1) Where given, Master Quote numbers or other quotation numbers have been provided as a convenience to Bidders and are intended to be used for bidding purposes only.
      2) Bidding Equipment List subsystem sections, where a Master Quote has been provided, may only show a small number of items to help convey the design intent of the subsystem. Refer to the Master Quote for the expanded list of subsystem components.
      3) A Master Quote may not be inclusive of all components or accessory items necessary to provide for a complete, functioning and properly integrated subsystem. The Bidder shall include all miscellaneous materials that may be required to complete the subsystem.
      4) Where discrepancies between a Master Quote and the Bidding Equipment List exist, the Master Quote shall rule.
2. Design Verification and Documentation

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a. Generating and submitting Shop Drawings as required for approvals and As-Built drawings as specified herein.
b. The Contractor shall provide final complete and detailed designs, as well as complete and operational systems, based on the design intent outlined in the Specification. Any omissions, discrepancies, substitutions, or exceptions to the Specification identified by the Contractor shall be communicated to the Consultant as part of the Submittal process.
c. After completion of the Submittals process, the Contractor shall assume full responsibility for supplying complete and operational systems and final complete and detailed designs without claim for additional compensation. This shall include providing all equipment, Installation Materials, and labor needed to provide complete and operable system(s), even if such equipment, materials, or labor are not listed within this Specification, including the Bidding Equipment Lists.
d. After completion of the Submittals process, requests for additional compensation will only be considered based on the following conditions: Owner-requested changes, unexpected field issues due to work by other contractors, or schedule changes initiated by others.
e. If the Contractor fails to provide the required Submittals, the Contractor shall assume all responsibility for supplying complete and operational systems and designs without claim for additional compensation.
f. Generating and Submitting “Progress Reports” as defined herein.
g. Documenting the completed installed systems as defined herein.

3. Cabling, Equipment, and Installation
   a. Providing all cable in conduits for the specified systems. Place pull string in all conduits after cable installation is complete to allow for future cable installation.
   b. Providing station and user cables for connection of audiovisual equipment to associated data network outlets, table input plates, wall plates, floor boxes, and other connection points provided by the Contractor. Including but not limited to presenter’s computers, production computers, laptop connections, control system processors, codecs, displays, or other portable/user provided devices. This applies to all equipment installed by the Contractor, including Owner-Furnished (OFCI) items. Station cables for HDMI and other audiovisual-specific types shall meet all performance requirements specified herein. Coordinate station cable requirements for telecom cables with the greater building-wide structured cabling system.
   c. Coordinating and providing cable labels as stipulated by the Owner and/or specified herein.
   d. Furnishing and/or installing all equipment as specified.
   e. Installing Owner furnished equipment as specified.
   f. Providing speakers as complete assemblies with back boxes, grilles, tile bridges, wall mounts, hanging hardware and other installation hardware as required.
   g. Coordinating with the Architect and Owner on final color selection, and/or the painting of any exposed loudspeakers and any/all exposed system components to match the room’s aesthetics and finishes.
   h. Coordinating with local entities as necessary (manufacturer, Owner, SBE, FCC, etc.) to determine final channel selection for all wireless devices and resolve conflicts where they may occur.
   i. Providing to the Owner, upon completion, all accessories and ancillary items included with the manufacturer’s equipment but not used for the physical installation of the device. This shall include all user manuals, remote controls, batteries, tools, installation hardware, carrying cases, protective covers, loose cables, etc. Batteries shall be provided for all battery-operated devices, even if not included by the manufacturer.
   j. Furnishing all lifts, ladders, scaffolding or other resources as needed for proper safe installation. Coordinating with other trades as needed.

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k. Interconnecting all components, both internal and external to rack cabinets.

l. Ensuring that all cabling, equipment, and terminations are installed in accordance with accepted industry standards, approved Shop Drawings, manufacturer's recommendations and as stipulated herein.

m. Providing cable management hardware as required including; that required internal to rack cabinets; that required between pieces of equipment not housed in rack cabinets; and that required to extend cabling from rack cabinets and equipment to the greater facility cabling infrastructure.

n. Providing equipment mounting hardware as required including; that required for mounting equipment behind flat panel displays; that required to mount equipment within equipment racks; that required for other locations where equipment will be housed.

o. Providing custom cover plates, wall plates, I/O connection plates, floor box insert plates as required. Coordinate with the Architect and/or Owner on the final selection of finishes.

p. Ensuring that all equipment, with the exception of portable equipment, is firmly fastened or attached in place. A safety factor of at least five shall be utilized for all brackets, fasteners and attachments. Provide safety retention cables for overhead equipment such as loudspeakers, projectors, etc.

q. Ensuring that all equipment mounting styles and locations comply with the current ADA Standards for Accessible Design. If any device or location specified herein is found to be in conflict, a confirming RFI should be issued prior to relocating.

r. Providing all projector mounts, including guy wires, clamps, or support assemblies back to structural members. Obstructions vary from room to room; Contractor must pay close attention to this issue on a room-by-room basis.

s. Field verifying all projector locations and resolving any obstruction conflicts for optimal performance. The Contractor shall reference the infrastructure drawings for screen sizes and initial throw distance calculations. Field verify measurements to confirm throw distances and validate the appropriate lens requirement prior to procurement.

t. Providing all projector lenses as required.

u. Mounting / aligning the projectors so that digital keystone correction is not required. Optical lens shift shall be employed, only if necessary, to align the image with the image area. Where possible all projectors mounted below the ceiling shall be mounted and adjusted to be perpendicular to the screen surface.

v. Coordinating with the General Contractor and/or Electrical Contractor on the audiovisual control system connection to the projection screens, as required

w. Performing final adjustments to motorized projection screens provided by Others to include:

   1) Screen travel limits as required optimizing the amount of black drop in conjunction with projection system geometry, field conditions and manufacturer recommendations. Refer to the Drawings for specified dimensions.

   2) Tab-tension systems (where specified) to ensure a flat projection surface free of wrinkles, waves or other anomalies which might indicate that the tensioning cables require adjustment.

x. Providing a list of all Owner Furnished Contractor Installed equipment to the Owner including a date when all equipment must be received to ensure the installation is completed on time.

y. Providing any/all patching, caulking, fire stopping, and painting required to restore damaged finishes during installation.

4. Furniture

   a. Providing audiovisual lecterns and technical furniture as specified.

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b. Coordinating with the Consultant, Architect and Owner on the final selection of all technical furniture including design details (make/model), available options, dimensions, cable management needs, color, and finish.
c. Coordinating with furniture manufacturer or others who are providing all necessary furniture/millwork modifications ("cut-outs" or other) as required allowing for a neat and professional installation of integrated technology system components. This includes, but is not limited to: integrated table/lectern "cubbies", table-top microphones, cable management grommets, etc., and providing manufacturers' cutout templates to others when requested.
d. Coordinating with the furniture manufacturer, Owner, and Architect on cable management, thermal management, and equipment installation requirements in all spaces so equipped and as outlined in 'Installation Practices'. Providing manufacturer's product cut sheets and/or equipment samples where they may be needed to assist in the design by Others towards integrating such equipment into furniture systems or architectural features.

5. Coordination with Owner's Network
   a. Securing from Owner private IP addresses for use by Ethernet equipped audiovisual devices. No Ethernet equipped device shall be connected to Owner's network without the express permission of Owner. This shall include, but is not limited to configuration parameters such as DHCP, IP addresses, subnet information, VLAN setup and authorization.
   b. Confirming with the Consultant that coordination with the Owner regarding Ethernet equipped audiovisual devices as outlined in 'Submittals – Software'.
6. Programming and Software
   a. Developing and installing all custom control system programming code as required and/or as specified herein.
   b. Developing and installing all custom DSP programming code as required and/or as specified herein.
   c. Providing Control System design submittals and two Control System design revisions as outlined in 'Submittals – Software'.
   d. Providing centralized media control systems including GUI (Graphical User Interface) and code development in order to satisfy the guidelines outlined herein.
   e. Developing Control System help-desk and system administrator functionality as defined herein.
   f. Coordinating with the Electrical Contractor and/or others on the control system interfaces to mechanical systems including motorized screens, as specified.
   g. Coordinating with the Electrical Contractor and/or others on the low voltage control system interfaces to facility lighting where specified.
   h. Providing the executable (uncompiled) programming control code as defined herein.
   i. Developing and installing all custom software for DSP devices as required to optimize system performance.
   j. Configuring all installed components including the assignment of device host name, configuration of network settings, configuration of user and administrative access names and passcodes, and configuration of all settings required for proper operation within the specified system.
   k. Installing, configuring, and testing all manufacturer provided software applications included with the specified equipment.
   p. Coordinating Audio DSP settings with Consultant for the purposes of integrating any necessary recalls into the control software.

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q. Coordinating with Consultant to communicate any conditions or circumstances that do not satisfy the functionality described herein.

r. Loading and testing any control programming code updates prior to Substantial Completion and during the Warranty period.

7. Testing, Training, Acceptance, and Warranty

a. Ensuring that all individual components function as intended by this Specification.

b. Ensuring that the entire audiovisual systems function as intended by this Specification.

c. Testing, adjusting, and fine-tuning the completed systems and components.

d. Coordinating and participating in a Systems Performance Verification review with the Owner and/or Consultant.

e. Coordinating and conducting an acceptance walk-through and sign-off session with the Owner and/or Consultant.

f. Providing “sign-off” documents for each space and/or space type as defined herein.

g. Conducting training in systems operation for the Owner’s designated representative(s).

h. Providing a warranty service contract as defined herein.

C. Work Excluded: Work not included under this contract unless noted otherwise shall be:

1. Providing conduit, power receptacles, junction boxes, cable raceways, electrical back-boxes, and floor boxes.

4. Providing lighting fixtures, lighting dimming systems, lighting controllers, and lighting system low voltage AV interfaces at the dimmer side.

5. Providing millwork except where otherwise specified herein.

6. Providing wall or ceiling mounted projection screens, and projector lifts.

7. Providing recessed wall boxes for video cameras.

8. Providing blocking as required to support wall-mounted audiovisual components.

9. Providing window treatments and motorized shade system low voltage AV interfaces at the controller side.

10. Providing telecommunications structured cabling systems, including horizontal and backbone cabling and termination, voice and data face plates, associated racks and cabinets, raceway, and cable management.

1.9 JOB CONDITIONS

A. Space Conditions:

1. Architectural reference drawings provided to the Contractor for bidding purposes may not reflect construction site as-built conditions. It shall be the responsibility of the Contractor to field-verify all site conditions relevant to his/her work.

2. The Contractor shall verify dimensions of equipment, equipment arrangements, space availability (including any millwork or cabinetry provided by others) and provide systems that work within the constraints of the space available. The Contractor shall notify the Consultant of any situation where space constraints are a problem, prior to the submission of shop drawings or the ordering or purchase of equipment. The Contractor shall bear the expense of providing alternate equipment, which will work within the available space, if space availability problems are discovered after shop drawings are submitted and approved.

3. If new or changed space condition issues are identified by the Contractor or others after the approval of shop drawings, the Contractor shall provide a proposed solution for the identified issue. The proposed solution shall include any potential impact to cost and/or schedule.

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Proposed solutions will be reviewed and approved by the Owner, Architect and/or Consultant, or alternate solutions will be recommended.

4. Drawings indicate locations of equipment and components. Changes in the location, and offsets of same to accommodate building conditions, and coordination with the work of other trades shall be made prior to initial installation, without additional cost to the Owner.
5. The Contractor shall ensure during installation that access is provided to equipment and components requiring operation, service or maintenance within the life of the system.
6. It shall be the responsibility of the Contractor to identify any condition where the recommended environmental and/or electrical operating parameters for specified equipment/products cannot be assured. Should such condition exist, it shall further be the responsibility of the Contractor to notify the Architect and Consultant of any such condition.

B. Conduit and Cabling Pathways

1. The Contractor shall review and verify all conduit, boxes, and other cabling pathways as indicated in the infrastructure Reference Drawings and provided by others. This review shall include the drawings as well as as-built conditions on site.
2. The Contractor shall notify the Consultant, General Contractor, and Architect of any deficiencies, issues, or incorrect installations on site that may impact the installation of the audiovisual systems cabling or equipment as specified.
3. Failure to perform this review will result in a revised cabling approach to be designed, proposed, and implemented by the Contractor, with any additional costs borne by the Contractor.

1.10 LAWS AND REGULATIONS

A. All equipment, cabling, materials, and installation methodology shall conform to the requirements of the National Board of Fire Underwriters, the current published edition of the National Electrical Code, and all other applicable laws and regulations. The Contractor shall obtain and pay for any additional permits and inspections required by all legal authorities and agencies having jurisdiction over the Contractor’s work.

1.11 QUALITY ASSURANCE

A. Unless otherwise stated, all equipment for this installation will be new, less than one year from the date of manufacture, and without blemish or defect.

1. All electrical, electronic and optical equipment provided by the Contractor shall be a product of companies regularly engaged in the manufacture of electrical, electronic or optical equipment.
2. All equipment must be purchased from a manufacturer-approved distributor or reseller. Purchase of equipment from a non-approved reseller is prohibited.
3. The equipment shall be the latest model or type offered which meets the applicable specifications at the time of the submittal. Discontinued items replaced by newer models or versions are prohibited from use in the project. It shall be the Contractor’s responsibility to provide the Consultant with information regarding discontinued products listed in the specification.
4. Where applicable, all equipment must have the manufacturer’s latest firmware version installed prior to Testing and Systems Performance Verification.

B. Quality of workmanship and fabrication of all equipment and components, which are custom fabricated shall be comparable to professional equipment produced by specialized manufacturers of the trade involved and shall be verified by observation. Only firms having 10 years’ experience

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in all aspects of the fabrication and installation of similar systems shall be allowed to perform the work.

C. The work specified herein, and in each of the allied sections, shall be accomplished by a single Audiovisual Contractor experienced in the design, fabrication, installation, checkout and warranty contract management of systems such as those described in each section.

1. The Audiovisual Contractor shall have complete responsibility for the systems described herein and shall be the single contract point for the Architect, the Consultant and/or the Owner with respect to all work specified herein.

2. The Contractor shall maintain the same project manager and field supervisor throughout the installation, and where practical, maintain the same installers.

D. The Contractor shall supply and install any incidental equipment needed in order to result in a complete and operable system without claim for additional payment, even if such equipment is not listed in this Specification.

E. All work related to this Specification shall be completed in a professional manner by fully qualified workers.

1.12 POST-AWARD SUBSTITUTIONS

A. It shall be the Contractor's responsibility to provide the Consultant with information regarding products listed in the specification that have been discontinued or may not be available in time to meet the project schedule.

B. If a product listed is discontinued prior to installation or will not be available in time to meet the project schedule, the Contractor shall submit a Substitution Request.

1. Substitution Request shall include:

a. Name of material, product, or equipment originally specified.

b. Name of material, product, or equipment to be substituted.

c. Complete description of proposed substitution including cut sheets, drawings, performance data and other information necessary to demonstrate that the substitution will meet all intentions of this Specification or required for a complete evaluation.

d. Any requested changes to the contract value or project schedule.

2. Contractor shall assume and bear all responsibility for coordinating, documenting, and/or performing related changes in the Work necessitated by such substitution. This includes, but is not limited to, changes to other related audiovisual components, OFCI components, Installation Materials, architectural integration details, software programming, required infrastructure, and any related work provided by Others.

3. All requirements of the Specification shall apply to substituted products.

4. The Contractor shall receive written response within 5 working days of receipt of the Substitution Request by the Owner/Consultant.

1.13 RELIABILITY

A. General: The systems are designed to provide professional quality operation over a period of several years without the need for continual maintenance. Equipment that has a high failure rate is not acceptable for installation as part of the systems.

B. Warranty: The Bidder shall make known, in writing, at time of Bid any exceptions that might exist between conditions described herein and Bidders policy of warranty. After acceptance of bid, all conditions and requirements of warranty described herein shall apply.

1. The Contractor shall guarantee all equipment, materials, and labor for a period of 1 year from the date of Substantial Completion.

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2. Bidders shall maintain permanent fabrication, service and support facilities within (100) miles of the Project site during the Work and Warranty period.
3. During the warranty period, within 24 hours of notification, the Contractor shall answer all service calls and requests for information.
4. During the warranty period, within 96 hours of original notification, the Contractor shall provide emergency service to restore operation of the system, replacing defective materials, repairing faulty workmanship, making temporary repairs, and providing loaner equipment as necessary, all at no charge.
5. The Contractor shall notify the Owner before any service call whether such call is or is not covered under warranty. The Owner may be billed for non-warranty calls. The Contractor shall notify the Owner of any service call or work to be performed for which charges may be incurred before such work commences.
6. Improper functioning, for warranty purposes, means failure of the system to meet the intentions of the specification because of internal defects. It does not include Owner caused malfunctions such as re-adjustment of the controls, re-tuning of the system, or injury to the system beyond normal wear. Nor does the warranty cover paint, exterior finishes, fuses, lamps (including projection lamps) or associated labor, unless the damage or failure results from defective materials or workmanship covered by the warranty.
7. The Contractor shall take such actions at the time of installation to ensure that all equipment is installed in accordance with the manufacturer recommended environmental and electrical operating conditions and requirements. After installation, the Contractor shall be responsible for the repair or replacement of said equipment that the Contractor installs which fails due to environmental or electrical conditions, even if not covered by the manufacturer's warranty. The Contractor shall not be held responsible for damages due to changes in environmental conditions, which occur after the date of Substantial Completion.
8. Unless otherwise directed, the Contractor shall activate all manufacturer warranties in the Owner's name. The start date of the warranties shall be the date of Substantial Completion.
9. If the Contractor has modified certain components, the manufacturer warranty may be void. In this case, the Contractor is responsible for providing warranty coverage equal to that of the manufacturer.
10. Certain subsystems and system components may require installation by authorized representatives in order for the complete manufacturer warranty to apply. If this pertains to any subsystem or component for this project, it is the Contractor's responsibility to make arrangements for the complete manufacturer warranty to apply. These arrangements are to be at no additional cost to the Owner.
11. As part of the Bid Response, the Contractor shall provide the Owner with a proposal to extend the Warranty to cover Year 2, Year 3, and Year 4 of operation. These offerings are to include all parts and all labor; all conditions and restrictions listed above apply.

1.14 SUBMITTALS

A. General:

1. The Consultant shall review the Submittals and Shop Drawings listed below. Submittal and Shop Drawing review shall be based on conformance to the Specification and adherence to the design intent of the Specification. The Consultant's review of the Contractor's Submittal shall not constitute a certification of accuracy or completeness regarding equipment, quantities, installation techniques and details, control system software programming, audio DSP software programming, equipment interoperability, safety factors, scheduling, coordination with other trades, or any other aspects of the work which are the responsibility of the Contractor. The Consultant shall perform no more than two reviews per submittal listed below. The Contractor shall be responsible for providing any equipment, Installation

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Materials, and labor needed to result in complete and operable systems, even if such equipment, materials or labor are not listed within this Specification, including the Bidding Equipment Lists.

3. The Contractor shall maintain a Master Set of this entire Specification, including all drawings and addenda, at the site at all times during the installation. Any deviations from the Specification made during the installation shall be marked on this Master Set. The Master Set along with all relevant support documentation shall be provided as part of the As Built submittal in the format outlined under Final Documentation.

B. Submittal Format:

1. All documents, configuration files and drawings shall be submitted in the following format:
   a. Electronically in PDF format.
   b. Executable configuration file (where applicable).
   c. Other formats may be acceptable upon prior approval by the Consultant and/or Owner.
   d. All .PDF files shall be submitted at the documents' native scale. For example, a PDF created from a drawing whose native format was standard 'E' size (42"x30") shall be created at 42"x30" (full size) to ensure that there is no loss of resolution should the file be viewed or printed at a later date by the Owner.

C. Schedule:

1. The Contractor shall obtain from the Owner, Architect, or Consultant a project master timeline schedule showing projected dates when the relevant areas will be available to the Contractor for the on-site installation.
2. Within 15 days of notification of contract award, the Contractor shall provide a schedule of major project milestones to the Owner, Architect, or Consultant. The schedule shall show the following milestones, but may include others as required for overall site-work coordination:
   a. Shop Drawings and Submittals
   b. Order and receipt of materials
   c. In-shop testing to validate software functionality prior to on-site installation.
   d. Delivery of materials to the work site for installation by Others
   e. Delivery of major system components to the work site
   f. Receipt of Owner furnished equipment for installation by the Contractor
   g. Control systems GUI requirements meeting with Owner
   h. Development and submittal of control system GUI submittals
   i. Control System Control Surfaces / GUI Prototype Submittal review meeting with Owner
   j. Development and submittal of DSP submittals
   k. 50% completion of work by area
   l. 95% completion of work by area
   m. Installation of control system code
   n. 100% completion of work by area
   o. Testing and debugging on-site
   p. Final punch list
   q. Submittal of Final Documentation
   r. Training
3. If the Contractor feels that they will have any problems with meeting the scheduled project milestone deadlines, they must inform the Owner, Architect, and Consultant at the earliest possible opportunity.

D. Submittal Log

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1. Contractor shall provide a Submittal Log listing all required submittals, anticipated issue dates, and parties responsible for review.
2. The Submittal Log shall be maintained throughout the course of the project and made available to the Owner, Architect, Consultant, and General Contractor / Construction Manager when requested.

E. Progress Reports

1. Contractor shall submit a brief Progress Report via e-mail to the Consultant. The Progress Reports should be concise, utilizing bullet points or other efficient format.
2. The reports shall be submitted by noon on Fridays to Justin.Gurevitch@NV5.com, and bbarbaza@vbtmi.gov at the following intervals:
   a. After contract award, while working off-site: every two weeks
   b. While working on-site: every week.
3. Progress Reports shall list the following information in three sections:
   a. Progress: List the tasks accomplished since the previous report. This is to include both completed tasks and work-in-progress.
   b. Work Planned: List the tasks scheduled for the time period extending until the next report. This section should also include both completed tasks and work-in-progress.
   c. Issues. List any factors that are delaying progress or have the potential to delay progress that involve the Owner, Architect and/or Consultant.
      1) Provide a proposed solution for each issue listed. The proposed solution shall include any potential impact to cost and/or schedule. Proposed solutions will be reviewed and approved by the Owner, Architect and/or Consultant, or alternate solutions will be recommended.
      2) For equipment related issues, include a manufacturer's service ticket number, service log number, or similar means of documenting communications between the Contractor and manufacturer.

F. Shop Drawings

1. The Contractor must receive written approval from the Owner or an authorized representative of the Owner, in writing, prior to purchasing, fabricating or installing any equipment or materials. Approval to proceed will be given based upon Shop Drawings.
2. The Shop Drawings shall indicate complete details of work to be performed.
3. The Contractor shall provide one electronic copy (two copies, if printed) of the Shop Drawings each to the Owner and to the Consultant for review and approval.
   a. Drawings shall include a title block naming the Project, Consultant, and Contractor, shall include a drawing title, drawing number, revision number if applicable and date.
   b. Unless otherwise agreed to in writing, Contractor shall meet with the Owner and Owner's designated representative to review the Shop Drawing submittal. The Contractor shall be prepared to review the functional capabilities and characteristics of the systems for compliance with Owner requirements.
4. The Shop Drawings listed below are required of the Contractor. Submit all Shop Drawings complete as a single submission. Isolated items will not be accepted, except with prior approval.
   a. System Signal Flow – Complete functional system signal flow drawings of all systems described herein and meeting the functions indicated in the Specification. System Signal Flow/Shop Drawings to illustrate and identify:
      1) Each component indicating signal flow; signal type, connector types, and equipment interconnectivity.

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2) All used and unused input/output connections for all devices.
3) IP address and device host name labels for each component connecting to any IP network. If unknown at the time of Shop Drawings a placeholder must be shown and filled out as part of the As-Built drawing submission.
4) Physical location callout indicating the component's physical location (i.e. equipment rack #, lectern, wall mounted, etc.)
5) Cable fan-outs.
6) Wire/cable tags.
7) 70-volt loudspeaker tap settings.
8) Amplifier/loudspeaker zone assignments.
9) Patch panels, adapters, pre-made cable assemblies and other details as needed to accurately document the signal interconnectivity of the systems.

b. Equipment Locations
   1) The Contractor shall document the location of all audiovisual devices on the floor/ceiling plans, including the device's IP address, hostname, and/or a unique device name/code (as defined by the Owner).

c. IP Network Diagram – Complete functional network diagram of all network components required to support the systems described herein and meeting the functions indicated by this Specification. Network Diagram to illustrate and identify each major component including all switch accessories, uplink ports noted with bandwidth capacity, stacking cable connections noted with backplane bandwidth capacity, power supplies noted with PoE capacities per switch or switch stack, and other details as needed to accurately document the signal interconnectivity of the systems.

d. Cabling Schedule – Document complete wire run information, including the cable type, cable marker identifier, and origination and destination location and connector types for each cable. Wire run information shall be conveyed:
   1) Within the System Signal Flow drawings, and/or
   2) A separate list containing all wire run information

e. Examples representative of the Contractor's final cable marking technique for each cable type.

f. Loudspeaker Layouts – Scaled ceiling and/or floor plan drawings showing loudspeaker locations, including coverage patterns for ceiling-mounted loudspeakers. Loudspeaker zone groups shall be identified such that they are relatable to the System Signal Flow drawings.

g. Loudspeaker Mounting Details – Scaled drawings of complete loudspeaker mounting details, hardware and support surfaces, including details on all load requirements, safety factors, safety cables and structural materials.

h. Projector Mounting Details – Scaled drawings of complete projector mounting details, hardware and support surfaces, including details on all load requirements, safety factors, structural materials and any required safety cables.

i. Microphone Layouts - Scaled ceiling and/or floor plan drawings showing microphone locations and orientation within tables or fixed in ceilings and planned position of steerable microphone lobes if applicable.

j. Structural Anchorage – If required by the Authority Having Jurisdiction, provide structural calculations, drawings and details for the anchorage of equipment racks, loudspeaker rigging hardware, and all other mounts or hardware that attach to structure. The design shall be reviewed and approved by a Structural Engineer registered in the state in which the installation work is performed.

k. Optical Systems – The Contractor shall be responsible for field verification of the on-site conditions and submit scaled drawings to verify that the proposed projection devices,

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lenses and related optical systems will provide the desired image size without distortion, vignetting or any other image aberrations.

l. Panels – Scaled drawings of interconnect panels, control surfaces, and other custom interfaces.

m. Peripheral Equipment – Scaled drawings of mounting arrangements of any peripheral equipment, which may be included in this Specification.

n. Equipment Rack Layouts – Fully detailed rack drawings indicating equipment orientation within the equipment rack.

o. Technical Furniture – Scaled drawings of all technical furniture indicating the furniture dimensions, materials, finishes, equipment locations and orientation within the furniture, cable management accommodations, and all other details necessary to convey the physical and functional aspects of the furniture as it will be installed in each individual room space.

q. Others, as may be required by the Architect, Consultant or Owner.

1) Inquire with the Architect and Consultant whether submissions of finishes/materials which will be visible to the public are required and submit accordingly.

2) Typical sample items of interest include: receptacles and controls with associated trim plate and each type of loudspeaker baffle and/or grille.

5. Approval: The Contractor shall receive written response indicating approval to proceed, or changes required to the Shop Drawings submittal, within 10 working days of receipt of the submittal by the Owner/Consultant.

6. Modifications: The Contractor shall be responsible for updating the Shop Drawing package throughout the course of the project to document any Owner-requested changes, approved product changes, changes due to field conditions, or any other changes to the approved Shop Drawing package. Drawing modifications may be reviewed by the Consultant as-required, and the Contractor shall make current Shop Drawings available to the Consultant within seven calendar days of request.

G. Bill of Materials

1. The Contractor shall submit a comprehensive Bill of Materials concurrently with the Shop Drawing submittal.

2. The Bill of Materials shall be submitted electronically in Microsoft Excel format, unless an alternate format is approved in writing by the Consultant, Architect, or Owner.

3. The Bill of Materials shall be organized by room or system type, with a separate spreadsheet tab for each.

4. The Bill of Materials submittal shall contain at a minimum the following fields for each item: Quantity, Manufacturer Name, Manufacturer's Model Number, Description, Color/Finish (if applicable). Items that are Owner Furnished should be identified as such. Additional columns may be added for notes or other supplemental information as needed.

H. Owner Furnished Contractor Installed Equipment

1. The Contractor shall submit a comprehensive list of all equipment that shall be provided by the Owner for installation by the Contractor.

I. Product Cut Sheets: Upon request, the Contractor shall prepare a package of product cut sheets for review with the Owner at the time of the Shop Drawings review meeting. The Product Cut Sheets package is not a formal submittal to be reviewed by the Consultant

1. The package shall include manufacturer's cut sheets for all user interfaces, all exposed items not mounted in equipment racks, and all items requiring color or finish selection.

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2. The Product Cut Sheets package is not a means for proposing product substitutions. Requested substitutions shall be submitted via a 'Substitution Request Form' (Appendix D) including drawings, performance and test data, and other information necessary to demonstrate that the substitution will meet all intentions of the Specification.

J. Cabling: The Contractor shall submit specifications for each cable type to be used for the project.

1. The Contractor shall receive written approval from the Owner or an authorized representative of the Owner, in writing, prior to purchasing or installing any cabling.
2. The Contractor shall verify colors for all cabling that will be exposed or visible as part of the Submittal process.

K. Wireless Frequency Table: The Contractor shall submit a table of wireless devices including wireless microphones and intercom transceivers. Each device shall be listed individually along with the manufacturer recommended frequency setting per the location of the installation.

L. Equipment Rack Digital Photographs: The Contractor shall submit digital photographs of completed equipment racks for approval prior to delivering the racks to the project site.

1. All photographs must be properly exposed and focused, clearly showing the rear and front of each equipment rack. The rear photos must clearly show internal rack cabling, terminations, and cable management such as lacing bars and support brackets. Front photos must show equipment front-panels, labels, vent panels, blank panels, drawers, etc.
2. Subject areas must be free from glare as a result of flashes or other ambient lighting. Subject areas shall fill the image frame in a suitable manner. For large equipment racks, multiple exposures may be required, each indicating a separate portion of the rack.
3. All digital images shall be submitted in JPEG file format unless an alternate format is approved in writing by the Consultant, Architect, or Owner.

M. Network Coordination

1. The Contractor shall provide a private wired control network that shall function independently of the Owner's network.
   a. The Contractor shall coordinate with the Owner and verify which system components, if any, shall be connected to the Owner's network.
   b. The Contractor shall coordinate with the Consultant and verify which system components, if any, shall be connected to the Owner's network.
2. As indicated, the Contractor shall connect required AV components to the existing building LAN.
3. The Contractor shall work with the Owner's IT department to identify all PoE, VLAN, firewall and other networking requirements to provide a fully functioning AV system. The Contractor shall generate a schedule of all AV components that will be connected to the building LAN and submit it to the Owner's IT department for implementation.
4. The Contractor shall, as required, obtain from the Owner's IT department blocks of static IP addresses sufficient for current system implementation as well as future system growth.
5. The Contractor shall develop a device host naming scheme in coordination with the Owner's IT department to be assigned to each IP enabled device.
6. The IP Addressing schedule shall list, at minimum, for each connected device:
   a. Product make and model
   b. LAN port connection location
   c. VLAN Assignment – If applicable
   d. Assigned Static or DHCP Reserved IP address
   e. Product MAC address

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f. Device Host Name

7. The IP Addressing schedule shall be submitted electronically in Microsoft Excel .xls format, compatible with Windows 10 or newer operating systems, unless an alternate format is approved in writing by the Consultant or Owner.

8. Approval: The Contractor shall receive written response indicating approval to proceed, or changes required to the IP Addressing Schedule, within 10 working days of receipt of the submittal by the Owner/Consultant.

N. Software: The Contractor shall secure from the Owner or Owner's Representative, in writing, approval for all customized software applications prior to installation, including but not limited to:

1. Audio Digital Signal Processing (DSP):

a. The Contractor's Audio DSP submittal shall communicate the internal signal flow, preliminary setup and the configuration of the Audio DSP processors that is required to meet the AV systems functional and performance requirements. Final level settings and internal preset configurations shall be the Contractor's responsibility during system setup and commissioning.

b. Format: The preferred Audio DSP Systems submittal is the manufacturer's DSP software configuration files. If requested, the submittal may be provided in the form of signal flow drawings.

c. Audio DSP Software Configuration File Submittal Format:

1) Provide the manufacturer's software configuration files, custom designed for each unique system type, compatible with Windows 10 or newer operating systems.

2) DSP configuration files shall include custom labeling of all internal DSP device inputs and outputs provided with labeling capability. Labeling of the external hardware interface points shall match the externally connected devices as shown in the signal flow drawings.

3) The Contractor shall provide one copy of the electronic files to the Owner and one to the Consultant for review.

d. Audio DSP Signal Flow Drawing Submittal Format:

1) Provide block diagram signal flow drawings, custom designed for each unique system type and include at minimum the following information:

a) The audio DSP manufacturer make and model.

b) The system names and/or locations (room names) that will be served by the audio DSP device.

c) The names of all internal DSP components.

d) The names of all internal inputs and outputs.

e) The names of all external input and output connections.

f) Show interconnectivity between the internal components and I/O's (indicating DSP internal signal flow).

2) DSP signal flow submittals may be sized to match the AV signal flow drawings, in the form of JPEG image files (maximum 1920x1080 pixels) or PDF files.

3) The Contractor shall provide one copy each of the submittal to the Owner and to the Consultant for review.

e. The Contractor shall receive written response indicating approval to proceed, or changes required to the DSP submittal, within 10 working days of receipt of the submittal by the Owner/Consultant.

2. Control System Control Surfaces / GUI Prototype submittal

a. The intent of the Control System Control Surfaces / GUI Prototype Submittal is to create a base level collaboration process whereby the Programmer can solicit direction from the

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Owner and Consultant towards a mutually agreeable design. Unless otherwise agreed to in writing the Contractor shall meet with the Owner and Owner's designated representative to review the Control System Control Surfaces / GUI Prototype Submittal. The Contractor shall be prepared to review the functional capabilities as well as the aesthetic characteristics of the control surfaces for compliance with Owner preferences and standards.

b. Where Owner control surface or GUI standards are lacking, the Contractor shall provide:
   1) Preliminary control surface layouts for all pushbutton panels, touch sensitive panels, PC based controllers or other control surfaces. The Programmer should make the preliminary layouts with a monochrome, basic, wireframe style to clearly demonstrate the functionality of control surface. The layouts should illustrate all pushbuttons, labels, bar graphs, timers, video windows, etc. for each control panel and each system page. The Programmer should include suggestions for color schemes and graphic styles where applicable. The touch panel control surface submittal shall be created utilizing a collaborative, browser based application allowing for live review and comment by the Owner and Consultant, such as InVision or Moqups (UX design software).
   2) JPEG images (or PDF format file) of the finished look of all interface elements including but not limited to menu bars, buttons, down/up states of buttons, labels, bar graphs, timers, video windows, etc.
   3) A sample touch panel page as a separate file, or in a PDF format so that all parties understand the finished aesthetic.

c. Where Owner control surface or GUI standards are made available, the Contractor shall provide:
   1) Preliminary control surface layouts for all pushbutton panels, touch sensitive panels, PC based controllers or other control surfaces. The Programmer shall develop the preliminary layouts utilizing the Owner's standards. The layouts should illustrate all pushbuttons, labels, bar graphs, timers, video windows, etc. for each control panel and each system page. The touch panel control surface submittal shall be created utilizing UX design software for live review and comment by the Owner and Consultant.

d. The Contractor shall receive written response indicating approval to proceed, or changes required to the control surfaces layouts, within 10 working days of receipt of the submittal by the Owner/Consultant.

3. Control System Control Surfaces/GUI Submittal
   a. The Contractor shall generate a revised control surfaces layout submittal to include the additions, changes or revisions generated by the prototype submittal review as well as to integrate the graphic style into the design. The form and quantity of the submittal shall be as complete as possible and ready to be programmed unless otherwise directed. The touch panel control surface submittal shall be created utilizing UX design software for live review and comment by the Owner and Consultant.
   b. If the revised control surfaces submittal reflects those additions, changes or revisions called for in the prototype submittal review, the Contractor shall receive written approval to proceed within 10 working days of receipt of the submittal by the Owner/Consultant.

4. Post-Integration Control Surfaces Adjustments
   a. If so requested by the Owner or Owner's representative, and within 90 days of Substantial Completion, the Contractor shall be prepared to make one visit to the site to make final minor adjustments to the control system code or programming without additional compensation. This could include, but may not be limited to, renaming or changing the size or location of buttons, page flip calls, or adjustments to code to provide a fully functioning system. If engraved control system panels require modification at a

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cost to the Owner, such cost information must be submitted to the Owner for approval prior to any work being performed.

b. The Contractor shall be responsible for ensuring that any changes to the control system or control surfaces that are made post integration are appended to the Final System Documentation.

O. Cable Testing

1. The Contractor shall secure from the Owner or Owner's Representative, in writing, approval for all cable test reports prior to Final Testing and System Performance Verification. Test reports shall include testing of all systems cabling and shall include:
   a. Loudspeaker line testing:
      1) Low impedance loudspeaker lines:
         a) Impedance at 1000Hz.
         b) Polarity of installed loudspeakers.
      2) 70 volt loudspeaker lines:
         a) Watts load at 1000Hz.
         b) Polarity of installed loudspeakers.
   b. Analog audio microphone and line level cable testing:
      1) Continuity of each conductor.
      2) Signal loss.
      3) Signal polarity.
      4) Shielding.
   c. UTP, STP, F/UTP and S/FTP cable testing:
      1) Category 5, 5e and 5e+ cables:
         a) ANSI/TIA-568.2-D Category 5e Permalink test.
         b) ANSI/TIA-568.2-D Category 5e Channel test.
      2) Category 6 and 6+cables:
         a) ANSI/TIA-568.2-D Category 6 Permalink test.
         b) ANSI/TIA-568.2-D Category 6 Channel test.
      3) Category 6a and 7a cables:
         a) ANSI/TIA-568.2-D Category 6a Permalink test.
         b) ANSI/TIA-568.2-D Category 6a Channel test.
      4) Shield test (required for shielded cables only).
      5) Nominal Velocity of Propagation test.
      6) Testing to be performed using a Fluke DSX-5000, or equal.
   d. Fiber Optic cable testing:
      1) All fiber optic installed and patch cables shall be tested to meet loss and polarity standards:
         a) ANSI/TIA-568-C.3 Cable Link test.
         b) ANSI/TIA-568-C.3 Cable Channel test.
   e. 2K HDMI and Digital Signal cable testing:
      1) Wire test function.
      2) Testing to be performed using a Quantum Data 780a, or equal.
   f. 4K HDMI and Digital Signal cable testing:
      1) Wire test function.
      2) Testing to be performed using a Quantum Data 780b, or equal.

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h. Digital video coaxial cable testing:
   1) EDH, CRC & Jitter tests
   2) Eye pattern measurement

P. Preliminary As-Built Drawing Submittal

1. Upon completion of the work, and prior to Final Testing and System Performance Verification, the Contractor shall condense the Master Set along with any Shop Drawings into a single “As Built” drawing set. Any markings or deviations, which cannot be made clear on drawings, shall be accompanied by attached documentation, photos, or written addenda.

Q. Final Documentation Submittals

1. Within 30 calendar days following Substantial Completion, the Contractor shall prepare and submit a Final Documentation set to the Consultant. The Final Documentation Submittal shall include any and all adjustments or changes identified during the Preliminary As-Built Drawing Submittal review. All documentation shall list the Owner, Project Name, Consultant, and Contractor. Any documentation appended and reissued during the Warranty period shall also include this information.
2. Format: All documents and drawings shall be submitted in the following format:
   a. Electronically in PDF format, with a link provided for electronic file transfer.
   b. Other formats may be acceptable upon prior approval by the Consultant and/or Owner.
   c. All .PDF files shall be submitted at the documents’ native scale. For example, a PDF created from a drawing whose native format was standard ‘E’ size (42”x30”) shall be created at 42”x30” (full size) to ensure that there is no loss of resolution should the file be viewed or printed at a later date by the Owner.
3. Printed submittals
   a. If requested, provide (2) printed copies of all documents and drawings. The documentation shall be bound in three ring binders with covers and spines listing the Owner, Project Name, Consultant, and Contractor.
4. Documentation: The Final Documentation Submittal shall include:
   a. As-Built Drawings: The as-built drawings must reflect all changes to the system(s) made after the original bid documentation.
      1) The size of the as-built drawings shall be identical to the original drawings provided to Contractor.
      2) As-Built drawings shall conform to all of the requirements listed under “Submittals / Shop Drawings” listed above.
      3) Any markings or deviations, which cannot be made clear on drawings, shall be accompanied by attached documentation, photos, or written addenda.
      4) The Contractor shall include any additional drawings which are necessary to properly document the as-built systems, but not included in the bid documents, including:
         a) Rack elevations
         b) Custom panel details
         c) Patch bay layouts
         d) Cable pull lists
      5) Submission of digital As-Built drawings files, which are generated by the Contractor based on drawing files provided by the Consultant under separate agreement, shall be subject to submission by the Contractor as defined under said agreement.
   b. A schedule of IP and MAC Addresses for all Ethernet enabled AV devices, organized by room name and number.
   d. A complete cable testing schedule.

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e. A listing of each supplied item with manufacturer, model number and serial number, organized by room name and number.

f. Operator's manuals for each piece of equipment supplied by the Contractor.

g. Quick Reference Guides

1) The Contractor shall develop system operating instructions for the operations of all contractor-fabricated devices and installed equipment items as part of the work. These operating instructions shall include detailed descriptions of how to operate the system as a whole. Component manuals are not acceptable to meet this requirement unless approved by the Owner and Consultant.

2) Quick Reference Guides shall be one page (front and back as necessary) heat-laminated cards or tents providing simplified instructions for operation of all major system functions.

3) Content of the quick reference guide shall focus on the controls and must include high quality graphics / photos of the controls themselves with explanations and step by step instructions.

4) Pages shall be appropriately sized for the content required. (Half or other sized pages are appropriate for simple rooms.)

5) Described functions shall include as a minimum:

a) Power on/off

b) Source selection

c) Volume control

d) Connection of auxiliary sources

e) Other functions as appropriate for the system, such as lighting and shade control.

f) Coordinate with the Owner and the Audiovisual Consultant regarding additional content desired. For example, the Owner may wish to include instructions for contacting local support personnel.

h. Software

1) Where custom software is developed by the Contractor as part of this project, the system source code, passwords, and any associated related files, referenced files, and development software (and all relevant documentation and license) used to compile, develop, and build, etc. the executable code must be provided. The source code should be well documented in accordance with industry software engineering practices.

2) The software developer shall retain intellectual property rights; the Owner shall have a license for perpetuity for use as it applies solely to this project, including the right to modify/enhance. The software code may not be sold or used, in part or in whole, in any other project or application other than that intended by this specification, in part or in whole, by the Owner or any other party.

3) If a Subcontractor is used to write the software, the Contractor shall include, as part of the Final Documentation submittal, a signed letter on Subcontractor letterhead, granting the Owner ownership, use, and modification rights of the code and documentation as defined herein. The software shall be provided to the Owner via a link provided for electronic file transfer.

4) The Owner may supply the Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by the Owner. All such intellectual property shall remain the exclusive property of the Owner and shall not be used by the Contractor for any purposes other than those associated with delivery of the systems specified herein.

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i. Warranty Statement: A statement on the Contractor's letterhead listing the official start and end dates for the Contractor's warranty on all equipment, materials, and labor used in the project. The start date shall correspond with the established Substantial Completion date, and the end date shall be based on the timeframe of warranty coverage purchased by the Owner as part of the contract.

5. Delivery
   a. If the Final Documentation submittal is determined by the Consultant to be complete and accurate, the Consultant will approve the submittal and forward the Final Documentation package to the Owner.
   b. If the Final Documentation Submittal is determined by the Consultant to not be complete and/or inaccurate, the Consultant will return the package to the Contractor with a written listing of the required modifications. Upon completion of all of the required modifications, the Contractor shall resubmit the Final Documentation to the Consultant for approval. The Final Documentation Submittal, and therefore the project, shall not be considered to be complete until all required documentation modifications have been made and approved by the Consultant on behalf of the Owner.

1.15 TESTING AND SYSTEMS PERFORMANCE VERIFICATION

B. Final Tests

1. System Performance Verification Scheduling
   a. Upon approval of the Contractor's test report and receipt of the "Systems Performance Verification Request" form, the Contractor shall assist the Consultant in the final Systems Performance Verification. The Contractor shall allow three (3) days to perform the review at a time that is mutually acceptable to the Contractor and Consultant. The Contractor's representatives assisting in the performance of the Systems Performance Verification shall be thoroughly familiar with the details of the system and shall include the field supervisor responsible for installing, testing, control system programming, audio DSP programming, and commissioning the system.
2. System Performance Verification
   a. All control system, DSP and device programming shall be completed and in working order prior to the System Performance Verification.
   b. A physical inventory shall be taken of all equipment on site and justified against the Contractor's Bill of Materials submittal and the original Bidding Equipment Lists.
   c. The Consultant shall require tests completed by the Contractor which demonstrate the operation of all system components and to determine that the systems meet the criteria as outlined in 'Performance Standards'.
   d. The Contractor shall supply test equipment to be used during the System Performance Verification. The test equipment shall be present, in working order and connected prior to the System Performance Verification.
      1) Video Test Equipment
         a) Computer video signal generator(s) capable of outputting all signal types included in the system design. (Extron VTG 400DVI & Marshall Electronics V-SG4K-HDI or equivalent)
         c) Digital discs including both program content and test signals. Blu-Ray discs are required if players are included in the systems.
         d) Adapters and interconnect cabling as necessary to complete testing.
      2) Audio Test Equipment
         a) Analog Audio Signal Generator, Impedance Meter and Line Analyzer: NTi MR-PRO (or equivalent).
         b) Condenser microphone: Shure SM86 (or equivalent).

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c) Active speaker: Fostex 6301NE (or equivalent).
d) Digital Audio Signal Analyzer: NTi DL1 (or equivalent).
e) Hardware-based Acoustic Analyzer: NTi AL1 or NTi XL2 (or equivalent).
f) Software-based Acoustic Analyzer: Smaart with reference microphones and all necessary accessories (or equivalent).
g) Compact Discs (CD's) including both program content and test signals.
h) Media as necessary to test all playback and recording functions of the system. I.E. compact flash card, MP3 Player, USB media.
i) Adapters and interconnect cabling as necessary to complete testing.

3) Video and Audio Teleconferencing:
a) Contractor shall coordinate a test call with a far-end site scheduled for the time the Consultant is performing the Systems Performance Verification.

e. Contractor shall have tools available on the day of the System Performance Verification for system inspection and adjustments.
f. Contractor shall coordinate with Owner so that all spaces are unlocked and available for inspection.
g. Preliminary As-Built documentation shall be available for reference and inspection.
h. If the Contractor's work is found to be incomplete, and subsequent visits to the site by the Consultant are required by the Owner, the Owner may elect to have the Consultant's travel costs, billable time, and all other related travel expenses be deducted from the Contractor's final payment.

3. Punch List Report and Correction
a. Following the completion of the Systems Performance Verification, the Owner and/or Consultant will issue a punch list report to the Contractor, identifying omissions, adjustments, and corrections to the work necessary to meet the requirements of the Specification.
b. The Contractor shall correct all punch list items resulting in fully functional systems that meet all requirements of the Specification and can be utilized by the Owner as-intended.

1.16 SUBSTANTIAL COMPLETION

A. The project shall be deemed substantially complete by the Consultant and/or Owner at the stage in the progress of the work where the systems are sufficiently complete in accordance with the Specification so that the Owner can utilize the systems for their intended use.

1.17 TRAINING

A. The Contractor shall provide a total of four (4) hours of on-site training for the Owner's staff at a time that is mutually agreeable for the Owner and Contractor.
1. The Contractor should anticipate two sessions of 120-minutes each.
2. The Owner may choose to have the sessions spread out over a maximum of two (2) different days.
3. Address in the training the general configuration of the system, basic functionality, correct operation procedures, routine maintenance and upkeep.
4. The Owner shall be permitted to video record the Contractor-provided training sessions for the future use of training faculty and staff.

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1.18 EVENT TECHNICAL SERVICE

A. In addition to the training listed above, the Contractor shall provide a total of eight (8) hours of on-site technical assistance for an Owner-defined event. It is expected that this event will occur within the first 60 days after Substantial Completion.

1.19 FINAL ACCEPTANCE

A. Final Acceptance shall be granted by the Owner based on the successful completion of the following activities:

1. All items required to obtain Substantial Completion have been achieved.
2. Any punch list corrections not required to obtain Substantial Completion have been completed by the Contractor and accepted by the Owner and/or Consultant.
3. The Contractor's Final Documentation Submittals have been reviewed by the Consultant and deemed to be complete, and have been delivered to the Owner.
4. The Contractor has provided all required training for the Owner as defined herein.
5. Any remaining items required by the Specification, but not listed above, have been completed by the Contractor.

1.20 SUBMISSION FOR PUBLICATION

A. Prior written consent from the Owner is required before submitting any information about this project for publication or award. This shall include, but not be limited to, photographs, descriptions, drawings, renderings, equipment lists, or any other information regarding the project. If written consent is provided by the Owner, any submission for publication or award must properly credit the Owner, Architect, and Consultant.

PART 2 - PRODUCTS

2.1 APPROVED CABLING

A. The following table lists cabling products and types that have been pre-approved for use. This is not an all-inclusive list of the cabling products and types required to complete this project. The Contractor shall reference the cabling products in this table as a baseline of performance for each cable category. The Bidder or Contractor may submit cable part numbers, models and manufacturer's product other than those listed in this table for consideration and approval per the substitution procedures defined in this Specification. Acceptable alternate manufacturers include Liberty Wire & Cable, West Penn Wire, and Windy City Wire.

Type/Application	Description	Manufacturer	Model No.	Comment
Microphone or Line Level Audio	22 AWG STP	Belden	9451	or equal
Microphone or Line Level Audio – Multi Pair (2)	22 AWG STP	Belden	1814R	or equal
Microphone or Line Level Audio – Multi Pair (4)	22 AWG STP	Belden	1815R	or equal
Microphone or Line Level Audio – Multi Pair (8)	22 AWG STP	Belden	1817R	or equal
Microphone or Line Level Audio – Multi Pair (12)	22 AWG STP	Belden	1818R	or equal
Microphone or Line Level Audio – Multi Pair (16)	22 AWG STP	Belden	1819R	or equal
Microphone or Line Level Audio – Multi Pair (24)	22 AWG STP	Belden	1821R	or equal

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Type/Application	Description	Manufacturer	Model No.	Comment
Microphone or Line Level Audio – Multi Pair (32)	22 AWG STP	Belden	1823R	or equal
Audio – Coax - Digital	19 AWG Coax	Belden	1694F	or equal
Audio Line – Digital Ready – Single Pair	24 AWG STP	Belden	1800B	or equal
Digital Audio – CAT6	23 AWG UTP	Belden	4812	or equal
Loudspeaker or LV Power Supply, 10 AWG	10 AWG UTP	Belden	5T00UP	or equal
Loudspeaker or LV Power Supply, 12 AWG	12 AWG UTP	Belden	5000UE	or equal
Loudspeaker or LV Power Supply, 14 AWG	14 AWG UTP	Belden	5100UE	or equal
Loudspeaker or LV Power Supply, 16 AWG	16 AWG UTP	Belden	5200UE	or equal
Loudspeaker or LV Power Supply, 18 AWG	18 AWG UTP	Belden	5300UE	or equal
Digital Video (Up to 6GHz)	20 AWG Coax	Belden	1505A	or equal
Digital Video (Up to 12GHz)	18 AWG Coax	Belden	4694R	or equal
HDBaseT Shielded CAT5e+	4-Pair CAT5e+ F/UTP 350 MHz	Belden	1212F	or equal
HDBaseT Unshielded CAT6A	4-Pair CAT6A U/UTP 625 MHz	Belden	10GX12	or equal
4K Ultra-High-Definition Media Cable, Shielded	4-Pair F/UTP	Belden	2183R	or equal
USB Extension Shielded CAT5e+	4-Pair CAT5e+ F/UTP 350 MHz	Belden	1212F	or equal
Control (RS-232/422)	2-Pair 24 AWG Stranded TC	Belden	8102	or equal
Control (RS-232/422)	3-Pair 24 AWG Stranded TC	Belden	8103	or equal
Control (RS-232/422)	4-Pair 24 AWG Stranded TC	Belden	8104	or equal
Ethernet Control Unshielded CAT5e	4-Pair CAT 5e U/UTP 200 MHz	Belden	1583A	or equal
Fiber Optic Cable, Multi-mode	2 Strand MM OM4 Fiber Riser Cable	Belden	FI4D002R9	or equal
Fiber Optic Cable, Multi-mode	6 Strand MM OM4 Fiber Riser Cable	Belden	FI4D006R9	or equal
Fiber Optic Cable, Multi-mode	12 Strand MM OM4 Fiber Riser Cable	Belden	FI4D012R9	or equal
Fiber Optic Cable, Multi-mode	24 Strand MM OM4 Fiber Riser Cable	Belden	FI4D024R9	or equal
Fiber Optic Cable, Multi-mode	2 Strand MM OM4 Fiber Plenum Cable	Belden	FI4D002P9	or equal
Fiber Optic Cable, Multi-mode	6 Strand MM OM4 Fiber Plenum Cable	Belden	FI4D006P9	or equal
Fiber Optic Cable, Multi-mode	12 Strand MM OM4 Fiber Plenum Cable	Belden	FI4D012P9	or equal
Fiber Optic Cable, Multi-mode	24 Strand MM OM4 Fiber Plenum Cable	Belden	FI4D024P9	or equal

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Type/Application	Description	Manufacturer	Model No.	Comment
SMPTE 311M HDTV Cable	1 Channel SMTE 311M HDTV Fiber Cable	Belden	7804R	or equal
SMPTE 311M HDTV Cable	3 Channel SMPTE 311M HDTV Fiber Cable	Belden	7824R	or equal
AMX DXLink Shielded CAT5e+	4-Pair CAT5e+ F/UTP 350 MHz	Belden	1212F	or equal
AMX DXLink Unshielded CAT6A	4-Pair CAT6A U/UTP 625 MHz	Belden	10GX12	or equal
AMX AXLink Cable	22AWG Shielded Pair 18AWG Power Pair	Belden	1502R	or equal
Crestron DM 4K Ultra Cable Shielded CAT7a	4-Pair 7a S/FTP 1000 MHz	Crestron	DM-CBL-ULTRA-NP	or equal
Crestron DM 4K Ultra Cable Shielded CAT7a	4-Pair 7a S/FTP 1000 MHz, Low Smoke	Crestron	DM-CBL-ULTRA-LSZH	or equal
Crestron DM 8G+ Shielded CAT5e+	4-Pair CAT5e+ F/UTP 350 MHz	Crestron	DM-CBL-8G-NP	or equal
Crestron Fiber Optic Cable, Multimode	8G Multimode Fiber Optic Cable, 50/125 x4	Crestron	CRESFIBER-8G-NP	or equal
Crestron Fiber Optic Cable, Singlemode	8G Singlemode Fiber Optic Cable, x2 zip-cord construction plenum/non-plenum	Crestron	CRESFIBER-8G-SM-P	or equal
Crestron (Cresnet) Cable	2-18 AWG UTP with 2-22 AWG STP	Crestron	CRESNET-NP	or equal
Extron XTP/DTP Shielded CAT6+	4-Pair CAT6+ SF/UTP 475 MHz	Extron	XTP DTP 24	No Known Equal
Wireless Microphone Antenna Extension	RG213/U	Belden	8267	or equal
Ampetronic Hearing Loop Copper Foil Tape	18mm x 0.25mm Single Conductor	Ampetronic	FB 1.8	No Known Equal
Ampetronic Hearing Loop Direct Burial Cable	1.0mm dia. (18 AWG) Single Conductor, Buriable	Ampetronic	DBC 1.0	No Known Equal
Ampetronic Hearing Loop Direct Burial Cable	2.5mm dia. (10 AWG) Single Conductor, Buriable	Ampetronic	DBC 2.5	No Known Equal
Williams Sound Hearing Loop Copper Foil Tape	0.75 in. x 0.010 in. Single Conductor	Williams Sound	PLW F	or equal
Williams Sound Hearing Loop Cable	18 AWG Single Conductor	Williams Sound	PLW 037	or equal
Williams Sound Hearing Loop Cable	14 AWG Single Conductor	Williams Sound	PLW 014	or equal

B. Environmental Suitability: The cabling listed above is all Indoor rated (non-plenum). The Contractor is responsible for providing equivalent cabling that is appropriate for the environment in which it is installed.

1. All cables running below slab on grade or in an outdoor setting shall be Outdoor rated.

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2. All cables being installed within a plenum environment must be Plenum rated.

C. All connections between mobile equipment and connection panels must be prefabricated, stage-grade cabling.

2.2 EQUIPMENT

A. Bidding Equipment List (BEL)

1. Bidding Equipment Lists are provided to the Contractor for use in preparing the bid response. These lists include major system components and peripherals, but should not be considered to be all inclusive. The complete equipment package bid response will take into account this document, all drawings, written addenda, any or all drawing additions or reissues, as well as implied system operability.

2. Bidding Equipment Lists are included as an Appendix in this specification.

B. Connectors, Adapters and Assemblies

1. Field terminated connectors shall be compatible and approved for use for a specific cable type and application by the cable and equipment manufacturer.

2. Connectors shall be manufactured by Neutrik, Switchcraft, AMP, Amphenol, Kings, Canare, Crestron, Extron, or equal.

3. Manufacturer constructed cable adapters and assemblies shall be provided by Crestron or Extron, or be of equal quality and durability.

C. Panels, Plates and Keypads

1. The Contractor shall provide a cover panel for all junction boxes which comprise the audiovisual infrastructure (wall, floor and ceiling). This includes pull boxes, splice boxes and unused or abandoned junction box locations.

2. Custom Fabricated Panels and Plates

a. Submit custom panel designs per Submittal requirements prior to fabrication or purchase.

b. Custom panels and plates shall be machined aluminum, nominal thickness 0.125”, with beveled edges and a brushed, anodized finish. Confirm with the Architect required finish color for each panel location. Use of the pull-box manufacturer’s construction cover shall not be permitted.

c. All panel connectors shall be labeled with engraved lettering, minimum 0.10” letter height, and provided with contrasting paint fill.

d. Panels and plates for non-gang pull boxes shall extend past the height and width of the pull box by a minimum of one-half inch on each side.

e. Cable access holes in cover plates shall not capture the cables and shall have a protective grommet to prevent cable damage.

3. Manufactured I/O Panels, Control Panels, Keypads and Plates

a. Submit proposed panel designs per Submittal requirements prior to purchase.

b. Panel functionality shall be as defined in the Specification.

c. Coordinate color and style with the Architect and/or Consultant.

4. Abandonment Cover Plates at Future Use, Unused or Abandoned Audiovisual Junction Box Locations

a. Submit proposed abandonment plate selections per Submittal requirements prior to fabrication or purchase.

b. Contactor shall coordinate with the Architect and/or Consultant regarding the style, finish and paint color of abandonment cover plates.

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c. Cover plates for standard gang junction boxes shall match the manufacturer style and color of architectural cover plates used elsewhere on the project.

d. For non-standard gang junction box locations provide the box manufacturer's paintable abandonment finish plate.

e. At non-standard gang sized junction box locations where a manufacturer's abandonment finish plate is not available, a custom, paintable abandonment plate shall be provided. Custom abandonment plates shall be sized to extend past the height and width of the box by a minimum of one-half inch on each side to mask any gap between the box edge and wallboard.

D. AV Rack Accessories

1. Provide manufacturers' rack mount adapters where available.

2. Where manufacturers' rack mount adapters are not available, provide Middle Atlantic Products RSH4S-series custom rack shelf adapters, with –C clamping option as appropriate, or equal.

3. Blank rack panels: Flanged steel with black textured powder coat finish, Middle Atlantic Products, SB-series, or equal.

4. Vented rack panels: Middle Atlantic Products black powder coat finish VT-series, or equal.

5. Rack screws, lacer bars and accessories: Middle Atlantic Products, or equal.

6. Rack Drawers: Middle Atlantic Products, black textured powder coat finish, TD-series, or equal.

7. Rack ID Panel: Include single space (1 RU) rack ID panel, RCI Custom Part# NV5001-250217MM-02 at the top of each equipment rack, or group of racks. Panel shall be digitally printed with logo and contact information for Consultant and Contractor. Manufacturer contact: quotes@rcicustom.com

8. Confirm with the Owner any requirements for security-type rack rail screws, prior to rack fabrication and assembly. Rack rail security screws shall be Middle Atlantic Products, approved style and installation/removal tool type, or equal.

9. Where locking doors are provided, confirm with the Owner any requirements for keying and, if requested, provide locks keyed alike at no additional cost, if available.

E. AV Rack Power Distribution Equipment

1. Where the Technical Power supply to the rack is IG (isolated ground), provide a power distribution system within the rack that maintains the integrity of the IG system.

2. Where 20A power is specified, ensure that all power distribution products are rated for 20A.

3. Vertical power strips: Middle Atlantic Products PDT-series, or equal.

4. Rack rail power strips: Middle Atlantic Products PD-series, or equal.

5. Provide a sufficient number of AC convenience outlets to accommodate all installed equipment plus an extra 20% spare capacity.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

A. General

1. All equipment shall be installed in accordance with this Specification, approved Shop Drawings, and manufacturer's recommendations.

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2. All equipment with the exception of portable equipment shall be firmly fastened or attached in place. A safety factor of at least five shall be utilized for all brackets, fasteners and attachments. Provide safety retention cables for overhead equipment such as loudspeakers, projectors, etc.
3. In the installation of equipment and cable, consideration shall be given not only to operational efficiency, but also to overall aesthetic factors.
4. The Contractor shall ensure that all equipment is installed such that proper cooling and ventilation is provided.
5. All equipment shall be installed in a manner, which prevents hum, RF/EMI/EMF interference, and mechanical vibration based noises (e.g. fan mounts, etc.)
6. Projectors, lenses, and mirrors shall be solidly mounted and braced so that there will be no observable movement in the image induced by motor vibration or other mechanical operations.
7. All equipment that includes keyed locks shall be keyed alike, per equipment category. This includes, but is not limited to equipment racks, lecterns, other technical furniture, security mechanisms, etc. The Contractor shall coordinate with the Owner on keying preferences before ordering equipment.
8. All equipment shall be protected from construction dust and debris until the date of Substantial Completion.
9. All equipment shall be protected from theft, damage, or vandalism until the date of Substantial Completion.
10. Any equipment designed for use by end-users in the facilities must be installed with theft deterrence/protection mountings and fasteners. Any tools required to mount/un-mount this equipment must be furnished to the Owner at the date of Final Acceptance.

B. Furniture

1. The Contractor shall ensure that equipment or mounting hardware is compatible with and suitable for installation in furniture specified by the Architect, Consultant, or Furniture Supplier. It shall further be the Contractor's responsibility to ensure that such coordination with the Architect, Consultant, or Furniture Supplier occurs. The Contractor shall exchange with and follow such Shop Drawings as to ensure that dimensions and structural supports are adequate for the installation of specified equipment. In addition, the Contractor shall confirm that the furniture accommodates the audiovisual equipment's' environmental and electrical operating parameters. It is the Contractor's responsibility that the request and delivery of such critical coordination information is satisfactorily executed. In as much as the Contractor has control over the delivery of such information, they shall deliver it as requested by the Architect, Consultant, or Furniture Supplier.

C. Equipment Racks and Equipment Rack Cable Management

1. Racks shall be installed in such a way so as to permit access to all equipment for service.
2. Racks are considered complete components and should be completely assembled and tested at the Contractors facility prior to onsite installation.
3. All equipment in racks shall be fitted with vent panels and/or fans as required to provide ventilation and cooling according to equipment manufacturer's recommendations.
4. Unused front facing rack spaces shall be fitted with blank rack panels.
5. Adjacent racks shall be bolted together with appropriate ganging hardware.
6. Use rear and mid rails for intermediate terminations. Maintain accessibility to the rear of the equipment.

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7. Mid rails must be used to support equipment weighing more than 50 pounds.
8. As a general practice, all power cables, control cables, and high-level cables shall be dressed to the left rear of an equipment rack. Audio and video cables shall be dressed to the right rear of the rack. Audio, video and control cables shall be bundled separately and spaced not less than three (3) inches apart.
9. Internal equipment rack cabling shall be supported by lacing strips, support brackets, or other cable management systems as required to ensure that all cabling is supported in both the vertical and horizontal planes within the rack.
10. With the exception of ganged equipment rack assemblies, cabling routed between equipment racks or pieces of equipment exterior to equipment racks, or extending to the greater facility cabling infrastructure, shall be completely protected, end-to-end, by a raceway, wire-way, or duct appropriately sized for the cable run.
11. Cabling between rolling pieces of equipment not housed in rack cabinets or a rolling equipment rack and any device to which it is connected, shall be protected by a split-loom corrugated tubing wrap or other such flexible cable management system appropriately sized for the cable run.
12. Any controls not to be adjusted by the user and accessible from the front of the equipment rack must be furnished with security panels.
13. Devices installed behind flat panel displays shall be mounted near the edge of the displays for easy physical access and for easy visual verification of indicator lights.

D. Video Displays

1. All permanently mounted projectors shall be installed with the center line of the projector perpendicular to the projection screen. All projected images shall be squarely converged to the projection screen. Keystone or geometric correction shall not be employed without the written consent of the Consultant.
2. Turn off or disable all eco, green or energy saving modes on all flat panel and projector displays where displays are to be controlled by an external control system
3. Video settings should be adjusted on all flat panel displays to optimize color and contrast. Settings should be identical between multiple displays within the same room, area, or room type. Any dynamic contrast modes within flat panel displays shall be disabled.

E. Video Cameras

1. Configure all video cameras with proper output resolution, network settings, physical positioning and white balancing. White balancing of cameras shall occur after the camera is installed, the room finishing is complete with the room lighting and shades properly set.
2. Program no less than four presets for all PTZ cameras.
3. Prior to installation, the Contractor shall work in close coordination with the Owner to determine the optimal locations for all video cameras to ensure that the camera positions meet the requirements of the Owner for the field of view.
4. If so requested by the Owner or Owner’s representative, and within 90 days of Substantial Completion, the Contractor shall be prepared to make one visit to the site to make adjustments to the locations of the video cameras within accessible ceilings without additional compensation. If camera placement is required in an inaccessible ceiling or wall and will incur a cost to the Owner for finishing, painting, cable pathways, mounting, etc., such cost information must be submitted to the Owner for approval prior to any work being performed.
5. The Contractor shall be responsible for modifying and reissuing any items within the Final Documentation package that have been impacted by post integration camera adjustments.

F. Cabling

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1. All cabling and termination shall be executed in adherence to standard industry practices and as outlined in:
   a. AV Installation Handbook: Best Practices for Quality Audiovisual Systems: AVIXA/InfoComm International, latest edition.
   b. Philip Giddings - Audio Systems Design and Installation: Boston Focal Press, latest edition.
   c. Kenneth T. Deschler - Cable System Design and Installation: McGraw-Hill, Inc. latest edition.
2. Cable Length Verification: Cable lengths where given in the Specification, for bulk or manufactured cable assemblies, have been provided to assist the Contractor in the bidding process. Cable run lengths, where specified, are end-point-to-end-point estimates and include consideration for tails. Estimates may be based upon cable tray systems; raceways, conduit runs, and furniture layouts indicated on construction drawings and may vary from the actual installed cable pathways. It is responsibility of the Contractor to field verify required cable lengths for bulk cable or manufactured cable assemblies prior to ordering.
3. Cable Installation
   a. Non-contiguous cable support mechanisms such as hangers, rings, and hooks shall not be spaced farther than four (4) feet apart. All manufactured raceways used for cables shall be installed according to the raceway manufacturer's specifications
   b. Cable runs shall be supported with devices designed for this purpose and are to be installed independent of any other structural component.
   c. Cables routed vertically up walls, or between floors as vertical riser, shall be supported with clamps or other mechanisms. These supports shall occur at least three times per floor.
   d. The Contractor shall maintain, or where not already existing, provide through penetration fire stop systems to prevent the spread of fire through openings made in fire-rated walls or floors to accommodate penetrating items such as conduit, cables or other pathway. Fire stop shall restore floor and wall to the original fire rated integrity. The fire stop systems and products shall have been tested in accordance with the procedures of U.L. and material shall be U.L. classified as materials for use in through-penetration fire stops.
   e. The fire stop system shall comply with the NEC and with NFPA 101-Life Safety Code (latest edition) and shall be made available for inspection by the local inspection authorities prior to cable system acceptance. The Contractor shall be responsible for verifying the fire rating of all walls and floors affected by his/her work.
   f. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.
   g. Cable pulling tension may not exceed manufacturer recommendations. Where cable-pulling lubricant is used, the lubricant must be compatible (non-damaging) with the conduit and cable sleeve materials and must not harden over time to prevent future pulls.
   h. Cable stapling of any recognized media type shall not be permitted.
   i. Cables shall be dressed in conveniently sized bundles and either laced or banded. Lacing or banding shall not be so tight as to deform cable bundles. Hook and loop cable ties shall be utilized, and plastic zip ties are not permitted.
   j. Cabling installed with a bend radius less than that recommended by the cabling manufacturer is not acceptable.
   k. Cables and bundles terminating at equipment or connector panels shall be supported so as not to put strain on connections or connectors.

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l. All cabling between mobile equipment and connection panels must be prefabricated, tactical cabling.

m. All cabling between network ports, jacks, patch panels and equipment must utilize prefabricated CAT6a, or better as required by the application, patch cables of appropriate length.

n. All cables, with the exception of video or pulse cables, which must be cut to an electrical length, shall be cut to the length dictated by the run. No splices shall be permitted in any pull boxes without prior approval of the Consultant.

o. Cabling for equipment mounted in drawers or on slides shall be provided with a service loop of appropriate length. A cable management support for the service loop shall be provided to prevent the service loop travel from interfering with the operation of the drawer or slide or snagging on adjacent cabling.

p. Microphone level, line level, loudspeaker level, and video lines shall be run in separate conduits, trough, raceway divider, and cable bundles. Low voltage DC and control may be run along with any but microphone or line level audio runs.

4. Termination

a. All termination components must meet or exceed all specifications for given media type and application as described in this document and system drawings.

b. Crimp on connectors shall be installed only on the appropriate size cable using the manufacturer recommended crimp tool and die set.

c. Connections to electronic devices providing screw terminals shall be terminated using the appropriate gauge insulated spade or ring crimp terminal connector and crimp tool.

d. All mechanical solder-on connectors shall be attached to cable ends using rosin core solder.

e. Audio signal cable shields shall be protected with the appropriate gauge Teflon or heat-shrinkable tubing. The jacket end of each audio cable shall be fitted with the appropriate gauge heat shrinkable tubing to provide additional protection to the base of the shield or shield foil. This also applies to the inside of mechanical connectors and cables that terminate at partitioned barrier strips.

5. Analog Audio Microphone and Line Level Systems

a. General

1) All analog audio microphone and line level cabling installed by the Contractor to support AV Systems connectivity shall meet the equipment manufacturer's specifications for cable and connector types, installation methods and routing, separation distance from adjacent services, maximum number of disconnect points and maximum overall cable run lengths required to meet the systems design performance criteria. The cabling system shall be tested, verified and documented.

b. Test for continuity of each conductor, polarity, signal loss and proper shield grounding and integrity.

c. Testing to be performed using an NTi MR-PRO Audio Generator and Impedance Meter, or equal.

6. Analog Audio Loudspeaker Line Level Systems

a. General

1) All analog audio loudspeaker line level cabling installed by the Contractor to support AV Systems connectivity shall meet the equipment manufacturer's specifications for cable and connector types, installation methods and routing, separation distance from adjacent services, maximum number of disconnect points and maximum overall cable run lengths required to meet the systems design performance criteria. The cabling system shall be tested, verified and documented.

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b. Test for continuity, polarity, impedance, signal loss and (if required) proper shield grounding and integrity.

c. Low impedance loudspeaker lines:

1) Test impedance at 1000Hz.

2) Test polarity of installed loudspeakers.

d. 70 volt loudspeaker lines:

1) Test watts load at 1000Hz.

2) Test polarity of installed loudspeakers.

e. Testing to be performed using an NTi MR-PRO Audio Generator and Impedance Meter, or equal.

7. Category Cabling and Connectors for AV Systems

a. General

1) All category cabling installed by the Contractor to support AV Systems connectivity shall meet the equipment manufacturer's specifications for cable and connector types, installation methods and routing, separation distance from adjacent services, maximum number of disconnect points and maximum overall cable run lengths required to meet the systems design performance criteria. Cables shall be bundled in groups of 24 cables maximum. The category cabling system shall be tested, verified and documented to meet the ANSI/TIA-568.2-D Standard, including all applicable Addenda.

b. HDBaseT and Similar Distribution Systems (DTP, XTP, DM, etc.)

1) AV Contractor provided signal distribution equipment that requires RJ-45 style connectors at room boundary wall panel or floor box panel connections, with the exception of those connecting a piece of AV equipment to the Owner's LAN, shall be color-coded Neutrik EtherCON CatX rated shielded panel connectors and manufacturer compliant shielded CatX rated inline connectors in the appropriate color-coded Neutrik EtherCON connector carrier and specified to keep the CatX rating of the signal cable. Manufacturer approved RJ45 cable connectors shall be used at all manufacturer equipment connections. All wires within the cable must be connected and shielded.

2) Each digital AV over RJ-45 receptacle, permanently installed cable, equipment cord, patch cord and patch panel will be of a color or have markings that are non-standard with the voice/data system, and be plainly and permanently labeled "AV ONLY".

c. AV Control Ethernet Systems

1) AV Contractor provided network equipment and connections for AV equipment control over Ethernet: all RJ-45 style room boundary wall panel or floor box panel connections provided by the AV Contractor shall be mechanically keyed with color-specific positive and negative keying features to prevent unintentional mating with unlike keyed or non-keyed patch cables.

2) Each digital AV permanently installed category cable, equipment cord patch cord and patch panel will be of a color or have markings that are non-standard with the voice/data system, and be plainly and permanently labeled "AV ONLY – NOT DATA".

d. Category Cabling Systems Installation and Testing

1) Where indicated, the Contractor will be required to provide a dedicated system of category cabling to support the transmission of digital AV signals. Depending upon the application, the cabling system topology may be point-to-point or be comprised of a system of work area outlets terminated at patch panels.

2) The Contractor shall test, verify and document the length, wire map and transmission performance of each Channel Link (Permanent Link + Station Cables) using a Fluke DSX-5000 Cable Analyzer System, including DSX-5000 Versiv Mainframe and

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Remote, LinkWare PC Software, CAT 6A/Class EA Permanent Link Adaptors and CAT 6A/Class EA Channel Adapters. This tester shall be used during testing of this project. Included features shall include the ability to integrate with labeling and cable management software, which yields downloadable 606-A cable IDs, ensuring data accuracy. Channel tests are the only acceptable test format for testing Category cabling. Link tests will not be sufficient.

3) All category cable Channel and Permanent Links shall be tested to prove compliance with the current industry standard, ANSI/TIA-568.2-D and any subsequent addenda. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-C including applicable Technical Service Bulletins and amendments. The appropriate level III tester shall be used to verify each individual type of category cabling systems.

4) Category 5, 5e and 5e+ testing of channel, permanent link and twisted pair cables shall be performed using the recommended test equipment specifically designed to test cables for all ANSI/TIA-568.2-D Category 5e parameters from 1 – 100 MHz. Testers shall be loaded with the most recent test values per the above referenced standard. The Contractor may be required to provide documentation (or demonstration) that the testers used are properly programmed as described above.

5) Category 6 and 6+ testing of channel, permanent link and twisted pair cables shall be performed using the recommended test equipment specifically designed to test cables for all ANSI/TIA-568.2-D Category 6 parameters from 1 – 250 MHz. Testers shall be loaded with the most recent test values per the above referenced standard. The Contractor may be required to provide documentation (or demonstration) that the testers used are properly programmed as described above.

6) Category 6A and 7a testing of channel, permanent link and twisted pair cables shall be performed using the recommended test equipment specifically designed to test cables for all ANSI/TIA-568.2-D Category 6A parameters from 1 – 500 MHz. Testers shall be loaded with the most recent test values per the above referenced standard. The Contractor may be required to provide documentation (or demonstration) that the testers used are properly programmed as described above.

8. Digital Video Cable Installation and Testing:

a. General

1) All digital video cabling installed by the Contractor to support AV Systems connectivity shall meet the equipment manufacturer’s specifications for cable and connector types, installation methods and routing, separation distance from adjacent services, maximum number of disconnect points and maximum overall cable run lengths required to meet the systems design performance criteria. The cabling system shall be tested, verified and documented.

b. When issues (such as cable length) compromise specifications or the integrity of the AV system, active cable equalization, twisted pair extenders, or fiber-optic extenders shall be employed as appropriate.

1) When using twisted pair extenders, the type of cable used and its shielding must comply with the extender manufacturer’s recommendations for optimum performance.

2) When using products that draw power from the +5V line, the system must be configured to ensure that source power is not overdrawn.

c. The bend radius of each cable shall not be less than the minimum recommended by the cable manufacturer.

1) System interconnects shall not exceed the minimum required for system functionality.

2) Cable splices, joiners, and gender changers shall not be used.

d. Test for continuity of each conductor, signal loss and proper shield grounding and integrity.

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e. Perform EDH, CRC & Jitter tests.

f. Perform Eye Pattern Measurement test.

g. Testing to be performed using a Phabrix SxE, or equal.

G. Labels / Wire Markers

1. For cable labeling, reference ANSI/INFOCOMM Standard F501.01:2015, Cable Labeling for Audiovisual Systems (CLAS)

2. Except where otherwise indicated, all rack-mounted equipment, switches, controls, and interface panels shall be clearly labeled.

   a. Panels and plates shall be a minimum 1/8" thick anodized aluminum etched and epoxy filled unless otherwise specified.

   b. Rack mounted equipment shall be labeled with engraved and filled plastic laminate. Where appropriate, the function of, or the input, output, or loudspeaker(s), served by each device shall be indicated. Other methods of labeling rack mounted equipment may be accepted pending prior approval by the Consultant and/or Owner.

   c. All cables shall be permanently identified at each end by machine printed cable markers.

      1) Every cable shall have a unique tag number identifier for each cable. The Contractor shall include this unique tag number on the As-Built signal flow documentation.

      2) Cable markers shall be placed two (2) inches from where the cable exits the strain relief of the connector, but never within a cable bundle.

      3) Each cable marker shall include, in addition to the unique tag number identifier, the device host name of the origination and destination equipment termination at each cable end (see example below).

A107 BRP-RM#-# AUDIO IN L RTR-RM#-# AUDIO OUT 12L	**A107** RTR-RM#-# AUDIO OUT 12L BRP-RM#-# AUDIO IN L
(BLU-RAY PLAYER WIRE END)	(ROUTER WIRE END)

H. Technical Power

1. Separate electrical power for media systems has been provided at this site and is designated as “technical power.” The technical power grid incorporates a grounding system utilizing a dedicated insulated ground cable for each receptacle, each of which is connected to the main technical power distribution panel. The Contractor shall be responsible for verifying that all media systems electronics, racks, and components derive their power from technical power receptacles only.

   a. All AC power distribution within equipment racks shall utilize a star grounding topology and isolated ground receptacles.

   b. Equipment rack power distribution systems shall be grounded by way of the 3-conductor AC line cord(s) provided with such equipment.

I. Grounding

1. To avoid system noise, data errors, safety hazards, and equipment damage, all devices and cabling shall be installed using a consistent grounding scheme.

3. This section offers guidelines for grounding and shielding methodology. Grounding and shielding methodology may need to be augmented or modified for certain pieces of equipment or interconnections in order to meet the requirements of other sections of this specification. The Contractor shall be responsible for making necessary alterations in accordance with industry practices and such that the Performance Standards detailed in ‘Performance Standards’ are met.

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a. Grounding and shielding systems shall be executed in adherence to standard industry practices and as outlined in:
   1) AV Installation Handbook: Best Practices for Quality Audiovisual Systems – Second Edition: AVIXA/InfoComm International, 2009
   2) Basics of Audio and Visual Systems Design handbook: Section 10, “Technical Power and Grounding Systems” – Revised Edition: AVIXA/InfoComm International 2003
b. Ground conductors referred to in this section shall be 10AWG insulated solid copper cable. Ground conductors shall be terminated using a closed ring lug, of proper size for each application, which shall be connected to system electronic components and the equipment rack master bus using nuts, bolts, and lock washers.
c. Under no circumstances shall an AC neutral conductor be used to ground equipment.
d. Audio and Video Patch Fields
   a) Unless otherwise specified, all patch fields shall be configured such that device outputs appear on the top row connectors of the patch field, and device inputs appear on the bottom row. Any exceptions to this rule require the prior approval of the Consultant.
   b) All connectors used on patch fields shall be of such design that they are electrically isolated from the patch field panel.
e. Interconnection
   1) All audio interconnections with cable lengths greater than 10 feet shall use balanced (differential) signaling.
   2) All connectors used on system I/O panels shall be electrically isolated from the panel and provide a pass through (uninterrupted) ground connection.
   3) All audio signal cable shields shall be grounded only at the output connection of each device. Signal cable shields, both connected to devices and floating, shall be protected by the appropriate gauge heat shrinkable tubing. Cable shields at the input connector end of the cable shall be folded back over the cable jacket and covered with heat-shrinkable tubing. Do not cut off unused shields.
   4) Microphone cable shields shall be connected at both ends.
   5) Coaxial video and RF shields shall be connected at both ends.

J. Pull Strings
   1. A nylon pull string shall be left in every conduit. In the event additional cables are pulled in after the initial cable pull, a nylon pull string shall be pulled with the added cable.

3.2 CONTROL SYSTEM SOFTWARE DESIGN & DEVELOPMENT

A. Control System Overview
   1. Extron control system processors shall provide local audiovisual systems and supplemental architectural device control for each of the controlled spaces.
   2. Extron touch panels, button panels and software applications shall be provided as the human interface devices for each of the control systems.
   3. Extron existing meta-control software and database servers shall provide asset management, control scheduling, help desk, messaging, system administration and reporting functionality for the local audiovisual control systems.
   4. Extron new room scheduling software and database servers shall provide room availability, room scheduling and meeting notifications for the room scheduling display system.

B. Meta Control System

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1. Where specified, the Contractor shall integrate the control systems into an existing Extron server-based meta-control system currently utilized by the Owner to provide capabilities that include Asset Management and Scheduling, Control System Help Desk and Messaging, and System Administration and Reporting.
2. The Contractor shall secure private IP addresses from the Owner for use by Ethernet equipped control system processors and control panels. The Contractor shall coordinate with the Owner, or representative of the Owner, to develop the required services, determine system user level access rights, and to establish control system network standards for TCP/IP addressing.
3. Meta control server software shall feature multiple user-access levels, assignable to any number of user logon accounts. Less-restricted accounts will be assigned to system administrators and security personnel, enabling them to monitor overall and equipment-specific status, take direct control over any control processor or control panel and generate statistical usage reports. More restricted accounts will be assigned to typical end users or presenters, enabling them to schedule a room, make equipment reservations, and specify the equipment “environment” for a room prior to the start of a meeting.
4. Extron control system processors and associated control panels will provide local control for all of the spaces. Each processor shall be equipped with either integral Ethernet port(s) and/or Ethernet expansion cards and memory expansion as required to support their operation. A connection between each processor and the building LAN will provide communications between the device and the Meta Control System.
5. Meta Control functionality shall include, but not be limited in the ability to:
   a. View real-time power status for all A/V systems facility-wide.
   b. Manually turn on/off A/V systems power in any room.
   c. Schedule A/V systems power on/off for individual rooms.
   d. Provide real-time status of video projector lamps.
   e. Provide self-generated equipment failure notifications.
   f. Create a database of equipment for asset management, tracking, and maintenance.
   g. Create reports, either scheduled or on-demand, indicating room and equipment usage.
   h. Schedule rooms, if desired, based on functionality, location, and availability.
   i. Provide Help Desk functions including chat and service notifications sent via e-mail.
6. Control system processors shall feature password protected remote login capability via a web-based interface, enabling the end user to directly monitor and control the processor via the LAN.
7. Where requested by the Owner, touch panel pages shall be converted, formatted, and exported for use with Apple® and/or Android® and/or Windows mobile devices.

C. Room Scheduling Display System
1. Where a separate Room Scheduling Display System is specified, the meta control server and database server shall provide software or software plug-in functionality to provide at each individual room display:
   a. Interactive room schedule and availability
   b. Interactive local room booking
   c. Digital signage display

D. Graphical User Interface / Touch Panels
1. General
   a. The following guidelines are not intended to limit the creativity of the Programmer when designing the software nor are they all-inclusive. Rather, they are concepts and

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guidelines to ensure that a fully functional, easy to operate control system for the Owner is provided.

b. The Control System shall employ an easy to use, intuitive, touch panel graphical user interface. Touch panel control shall be icon based and utilize graphical representations that mimic the actual device for all devices under control. In every case where the device under control offers feedback, the Control System shall provide indication on the touch panel(s) of individual component control state conditions.

c. A “Quit”, “System Shutdown” or similar button shall be available from the Main Menu. When the User has selected this button, a confirmation screen indicating that the shutdown sequence has been selected, and a message will pop-up reminding the User to remove all media such as Blu-Ray discs. A second button press shall be required to initiate the power down sequence. If a lamp-based component such as a video projector has a significant cool down and warm-up time between its on and off state, the warning should indicate that this particular device will be unavailable for a specified period of time. This might be done using a graphical representation of a clock, a countdown timer, bar graph, etc.

d. All pages shall maintain a consistent graphical “look and feel.”

e. The opening page should have, at a minimum, an Owner logo, a large button to start the system, and the ability to control the lighting system (and motorized shades if so equipped) without powering up the entire system.

f. After system start-up, the primary page or main menu in each presentation space shall display (at a minimum) a room identifier; all relevant input sources grouped together, all environmental controls grouped together, a quit option, a date icon displaying the current date, and a clock indicating current local time

g. The AV Contractor will determine with the Owner those control panels requiring passwords and limited access.

h. Each touch panel shall provide a method for service personnel to access detailed system information and configuration menus. This information might be accessed by service personnel via a hidden button and/or by entering a password. Configuration menus should include lowering projector lifts to the service position, projector zoom and focus, and other control functions useful to service personnel.

i. The information page should include the following: “System Designed by NV5. ph.(412)-323-8580 http://www.NV5.com/tech”; “System Installed by _____, ph. (xxx) xxx-xxxx, and website address; “Programming Supplied by _____“Program Name”; “Compiler Version X.0”; “Panel File #” ; and other relevant system software information.

2. Video Preview Function

a. Where specified components permit, a video preview function shall be provided on the touch panel.

b. The video preview function shall operate such that, when any video source is selected, its output will be automatically routed to a video preview window on the touch panel.

c. Touching the video preview window on the touch panel will toggle the video display between a predetermined sized video window and full screen display on the touch panel.

d. Control buttons for the selected video source device shall always be present below the video preview window and/or overlaid onto the full screen display.

e. Switching and control shall be such that a user may preview and cue video on the touch panel from a selected video source device at the same time that program material is running, uninterrupted, on the systems primary display device and sound reinforcement system.

f. Pressing a video source device button followed by pressing a ‘display’ (or similarly labeled) button will route the source’s video signal to the primary display.

3. Audio Control

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a. A volume control icon shall be available to the User at any time there is an audio enabled system.
b. Program audio: provide both level up/down and mute controls.
c. Speech audio: provide both level up/down and mute controls separate from the Program audio.
d. Microphone levels: when multiple microphone level control is required, provide a separate gain and mute control for each microphone in the mix. Microphone mix controls shall be on a separate, password protected setup page.
e. A clearly visible mute button with positive feedback to an on/off indicator on the touch panel shall also be included.
f. The AV Contractor shall set the system's master gain control such that the user has a reasonable range of audio level, but the maximum level is set below that which could allow the user to inadvertently cause harm to system components or cause feedback in the system.
g. The control system shall automatically reset the audio levels to an indexed preset level each time the system is shut down or restarted.
h. Pressing a video source device button followed by pressing a 'display' (or similarly labeled) button will route the source's video signal to the primary display. The source device's audio will be simultaneously routed to the room's sound reinforcement system (audio follow).
i. In systems with multiple assignable video displays:
   1) The video preview window shall include a button, or buttons, representing each assignable video display connected to the system. Where touch panel size permits, this should take the form of a graphical representation of the room with a display assignment button showing the relative location of each display.
   2) Pressing a video source device button followed by pressing a display assignment button will route the source's video signal to that display. This process can be repeated to assign a single video source to multiple displays.
j. In systems with multiple assignable video displays and a single sound reinforcement system:
   1) A method shall be provided by which users may select which video source's audio signal is to be routed to the room's sound reinforcement system (audio break away).
k. In systems with multiple assignable video displays and a multiple sound reinforcement systems:
   1) A method shall be provided by which users may select which video source's audio signal is to be routed to each sound reinforcement system (audio break away). An example might be a room with a projection screen that also contains multiple collaboration pods served by flat panel displays with integral loudspeakers.

4. Lighting Control
   a. Touch panel layouts will include lighting preset recalls in each room. A minimum of eight scene presets should be provided. For lighting zones where a dimming system is employed, the touch panel shall include "Brighter" and "Dimmer" or "Plus" and "Minus" buttons allowing the User to increase or decrease the level of lighting for any given preset.
   b. If so requested by the Owner, an Auto-Lights feature may also be provided for all or select spaces. The Auto-Lights feature, when enabled, would recall a specific lighting preset when, for instance, projection or video conferencing is called for.

E. Controlled Devices
   1. Where specified components permit, the Control System shall provide positive feedback of individual component control-state conditions to the touch panel. For example, the touch

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panel page to control a Blu-Ray player shall have a status window indicating the status of the device (such as “Play Mode”) or the absence of media (such as “No Disc”). If environmental controls are triggered with a particular device, the trigger for that environmental control should be feedback from the device rather than a simple button push. For example, if the control system is to automatically lower the lights when the media player is placed in “Play” mode, the control system should not directly trigger the lighting preset from the “Play” button press, but rather by first confirming that a disc is present in the player and that the player is in fact in “Play” mode.

2. Where specified, the AV Contractor shall provide a Control System interface to mechanical or electronic devices such as screens, window shades, or room lighting. Wherever such operation is available at the mechanical device under control, a stop or halt button shall always be provided in addition to buttons to drive normal equipment operation.
3. Remote power relays, when employed, shall be used to switch AC power to those devices whose power on/off function is otherwise not controllable. When such devices are audio power amplifiers, the Contractor shall program system control such that the audio power amplifiers are the last components to turn on during power up, and the first devices to turn off during power down.
4. Control system processors shall be programmed with an Auto Shutdown feature. Auto Shutdown will automatically power down a system at a given time unless overridden by the local User or System Administrator. Coordinate with the Owner via the submittal process described herein to confirm which systems shall have this feature. The Auto Shutdown feature shall function as follows: For any given room, when Auto Shutdown is set to “On”, the system will power down at a time specified by the Owner, 10:00 PM for example. Ten minutes prior to the specified time, the touch panel shall display a warning message and beep indicating that the system will shut down unless the local defeat button on the panel is pressed within the ten-minute time limit. Pressing the local defeat button will delay the Auto Shutdown sequence by one-hour, or other set length of time as requested by the Owner. Fifty minutes after the one-hour delay button has been pressed, the warning message and beep indicating that the system will shut down unless the local defeat button on the panel is pressed within the ten-minute time limit will appear. This sequence shall continue so long as the operator continues to press the delay button. Controls to adjust shutdown time, and defeat button duration shall be provided. This may be on a hidden or restricted-access page at the Owner’s discretion.
5. Resident PCs should be connected to constant power sources, not switched power, and should never be powered down from the control system.
6. If a device can play multiple types of media, has bi-directional communication with the control system, and its API permits, the system shall read the media type and adjust the screen options as appropriate for the playback option selected. For example, if a particular media player is able to play multiple media formats and has RS-232 control, the system shall display different options appropriate to that media type when detected by the unit (such as a video preview window and the ability to route the signal to a display device versus just audio playback transport controls). In this example, “graying out” the inappropriate buttons for options is acceptable.
7. For a video projector with an automatic set-up, auto image adjust or similar button, control of this feature should be provided on every logical page, such as VGA analog input pages.
8. For systems involving a video projector or similar display device, control the power to these devices separately. Users should be able to operate audio only playback devices, or control lighting or room dimming systems without automatically powering the projectors. If the system is initially started without projection, and the user subsequently attempts to project a source, the system should then ask if the user would like to power-up the projector(s) and if selected, display a progress bar during the warm-up process and then return to the current touch panel page.

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F. Videoconferencing and Cameras

1. The AV Contractor shall establish 4-6 go-to camera presets and provide a simple scheme whereby the User may easily recall these presets during a presentation. The Contractor shall determine all camera presets in coordination with the Owner. The setup of the camera presets shall be on a password protected technician's page, with provisions for naming each preset with variable text. This will allow the Owner to use descriptive text for preset labeling rather than simple numbering.
2. Manual camera control functions shall include zoom, pan and tilt. For camera zoom, indicate the lens control with a "Plus/Minus" or similar graphical icon based labels. For pan and tilt functions, use left, right, up, and down directional arrows mimicking the manufacturer handheld remote.

3.3 PERFORMANCE STANDARDS

A. Audio

1. Speech Signal
   a. The system shall provide a speech signal in the audience seating area that meets or exceeds the following requirements:
      1) Frequency response within ±3 dB from 500 Hz to 15,000 Hz.
      2) Overall SPL variance of ±3 dB.
      3) Measured Alcons of 10% or lower.
      4) Minimum average SPL of 87 dB Z-weighted (flat), with 10 dB of undistorted headroom available.
2. Music Signal
   a. The system shall provide a music signal in the audience seating area that meets or exceeds the following requirements:
      1) Frequency response within ±3 dB from 200 Hz to 17,000 Hz.
      2) Overall SPL variance of ±3 dB.
      3) Minimum average SPL of 93 dB Z-weighted (flat), with 10 dB of undistorted headroom available.

B. Video

1. Digital Video
   a. Based on the connectivity requirements provided by the AV systems design, the Contractor shall test the digital video system to ensure that it meets the following standards, as applicable:
      1) Single-link DVI
      2) Dual-link DVI
      3) HDMI (Latest Standard)
      4) DisplayPort (Latest Standard)
      5) Thunderbolt (Latest Standard)
      6) Mini DisplayPort (Latest Standard)
      7) USB-C (Latest Standard)
3. Digital Visual Interface (DVI)
   a. The Contractor shall test the video system to ensure that it meets the Engineering Standards of Version 1.0 of the Digital Visual Interface DVI specification document as released by Digital Display Working Group (DDWG), April 1999, which applies to digital and analog video signals with DVI connectivity. This Performance Standard applies

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mainly to DVI-D and DVI-I digital video connectivity. For DVI-A or DVI-I analog video connectivity, refer also to the Analog VGA Video paragraph herein.

b. At the points of interconnection, the input and output impedance of each link shall be balanced to ground, nominally 100 ohms ± 10 ohms.

c. Single link DVI shall support up to and including:
   1) 4.95 Gbps data rate
   2) 1920x1200 @60Hz resolution
   3) 60Hz vertical frequency

d. Dual link DVI shall support up to and including:
   1) 10.2 Gbps data rate
   2) 2560x1600 @60Hz resolution
   3) 60Hz vertical frequency

e. The proper shape of the digital video's RGB channels, or "eye pattern", as it appears on an oscilloscope, must be maintained. Refer to the DVI specification document by DDWG for required eye opening values and minimum standards for signal integrity

4. High-Definition Multimedia Interface (HDMI)
   a. The Contractor shall test the video system to ensure that it meets the Engineering Standards of the most recent HDMI Specification as administered by HDMI Licensing, LLC.
   b. At the points of interconnection, the input and output impedance of each link shall be balanced to ground, nominally 100 ohms ± 10 ohms.
   c. The proper shape of the digital video's RGB channels, or "eye pattern", as it appears on an oscilloscope, must be maintained. Refer to the HDMI Specification by HDMI Licensing, LLC for required eye opening values and minimum standards for signal integrity.

5. Display Port
   a. The Contractor shall test the video system to ensure that it meets the Engineering Standards of the most recent DisplayPort Standards as administered by the Video Electronics Standards Association (VESA).
   b. At the points of interconnection, the input and output impedance of each link shall be balanced to ground, nominally 100 ohms ± 10 ohms.
   c. System shall support up to and including:
      1) 10.8 Gbps data rate
      2) 2560x1600 @60Hz resolution
      3) 60Hz vertical frequency
   d. The proper shape of the digital video's RGB channels, or "eye pattern", as it appears on an oscilloscope, must be maintained. Refer to the DisplayPort Standards by VESA for required eye opening values and minimum standards for signal integrity.

6. High-Bandwidth Digital Content Protection (HDCP)
   a. All digital video sources, sinks, and repeaters shall comply with the most recent Digital Content Protection LLC specifications.
   b. All digital video sources, sinks, and repeaters shall scan for the presence of HDCP and if present, perform all HDCP stages according to the HDCP specification, with no more than 5 seconds total time delay between source selection or input and video appearing:
      1) Authentication and Key Exchange – Keys are exchanged and verified. The hardware will store / cache the Key Selection Vector (KSV) k_m to speed up video switching.
      2) If receiver is a repeater, data about downstream devices is sent to transmitter.

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3) Information is sent to transmitter every two seconds during entire HDCP session to ensure encryption is in sync between all transmitter/receiver pairs in the tree.

c. The distribution system shall authenticate all cached KSVs with each source up to the source's KSV limit, so that authentication does not need to be re-started each time content is routed to a new output.

d. The distribution system shall not send a source more KSVs than it supports.

7. Extended Display Identification Data (EDID)

a. All system components generating or accepting certain digital video signals shall provide the following information within the EDID transmission.

1) Product make, model, and serial number
2) Current EDID version and revision
3) Maximum image size
4) A table of supported input/output resolutions and timings
5) 3D support status for each input/output
6) Supported color formats
7) Supported audio formats for each input/output

8. Serial Bus Communications

a. Based on the connectivity requirements provided by the AV systems design, the Contractor shall test all serial bus communications links to ensure that they meet the following standards, as applicable:

1) USB 2.0 and 3.0
2) IEEE-1394b
3) Thunderbolt v1.2

9. Digital AV Over Category Cabling Systems:

a. UTP, STP, F/UTP and S/FTP cables installed for digital AV systems shall meet the following performance standards:

1) Category 5, 5e and 5e+ cables:
a) ANSI/TIA-568.2-D Category 5e Permalink Specifications.
b) ANSI/TIA-568.2-D Category 5e Channel Specifications.
2) Category 6 and 6+cables:
a) ANSI/TIA-568.2-D Category 6 Permalink Specifications.
b) ANSI/TIA-568.2-D Category 6 Channel Specifications.
3) Category 6a and 7a cables:
a) ANSI/TIA-568.2-D Category 6A Permalink Specifications.
b) ANSI/TIA-568.2-D Category 6A Channel Specifications

b. Cable performance definitions

1) NEXT: Near-End Crosstalk
2) PSNEXT: Powersum Near-End Crosstalk
3) ACRF: Attenuation to Crosstalk Ratio, Far-End
4) PSACRF: Powersum Alien Crosstalk Ratio, Far-End
5) ELFEXT: Equal-Level Far-End Crosstalk
6) PSELFEXT: Powersum Equal-Level Far-End Crosstalk
7) PSANEXT: Powersum Alien Near-End Crosstalk
8) PSAACRF: Powersum Insertion Loss to Alien Crosstalk Ratio, Far-End

c. Test Results

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1) Submission: Prior to Final Testing and Systems Performance Verification, the Contractor shall submit a copy of all applicable test results to the Owner/Technology Consultant in both electronic (file) and paper form.
2) Category cables: The test results submitted for category cables shall include the following:
3) Graphical/numerical data: Both graphical data plots and numerical data are required for the test parameters listed above.
4) The Category Cable Certification reports shall have complete testing of Permanent Links and Channel Links at frequency increments up to 500MHz as indicated in ANSI/TIA-568.2-D and shall include the following:
   a) Cable/Faceplate Number -- matching faceplate numbers on patch panels
   b) Test Date
   c) Cable Length
   d) Wire-Map
   e) Return Loss
   f) Insertion Loss
   g) NEXT Loss
   h) PSNEXT Loss
   i) ACRF
   j) PSACRF
   k) Propagation Delay Skew
   l) PSANEXT (Category 6A only)
   m) PSAACRF (Category 6A only)
5) Provide Category Cable Certification report and include as a minimum the following information:
   a) Test equipment make and model number.
   b) Test equipment calibration date.

C. Optical Systems
   1. Reference ANSI/INFOCOMM Standard 3M-2011, Projected Image System Contrast Ratio
   2. All video projection systems shall meet the following performance standards:
      a. The total averaged light output from a video projector, in ANSI lumens, shall be tested by the Contractor and certified to be within ±15% of that specified by the projector manufacturer.

3.4 SYSTEM SETUP, TUNING AND TESTING

A. The Contractor shall install, configure, adjust, program, and calibrate all components in order to optimize the performance of all individual subsystems and the system as a whole

B. Once the system is installed, the Contractor shall complete the following preliminary tests.
   1. Equipment Racks
      a. Unless otherwise agreed in writing, equipment rack(s) shall be completely assembled, tested and programmed in the Audiovisual Contractor's shop. No rack assembly shall be performed at the project site. After the equipment racks are tested the Audiovisual Contractor shall notify the Owner's Representative in writing that the equipment rack assemblies are ready for observation and approval. Allow adequate time for any modifications necessary to satisfy the contract drawings and specifications.
   2. Device Configuration

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a. Configure all devices as necessary for a complete and working system and as directed by the Owner or Consultant.
b. Apply User and Admin security settings, user name and passwords as directed by the Owner or Consultant
c. Configure all networked devices in coordination with the Owner and/or Consultant including the assignment of IP address, subnet, gateway, VLAN, security settings, and host names.
d. Apply host name for all devices within each device's setup utility.
e. Verify all networked devices are configured and registered to their respective network and free of any device to device communication errors and are reachable from the necessary devices.
f. Verify all networked devices are registered to each manufacturers' respective software or web-based configuration tool.
g. Set EDID settings, color space and output resolution settings per the project designated video image resolution.

3. Network Configuration
   a. Coordinate with the Owner's IT Department to provide required Firewall coordination, Internet services, VoIP phone provisioning, Email and Calendar credentials. DHCP Server, DNS Server, and/or Fully Qualified Domain Name (FQDN) as required to support the system functions indicated within the Specification.
   c. Provide configuration of the IP network to support the system functions indicated within the Specification. Provide configuration of network switches, switch stacking, power management, uplinks and connections to the Owner's network as required. Configure all network settings per device manufacturers requirements including IGMP, Designated Querier, VLan, PoE, and QoS.
4. Audio
   a. Prior to the termination of audio amplifiers to speakers, the Contractor shall measure the resistance of the speaker line with reference to ground to determine that no short circuits or paths to ground exist in the line. The Contractor shall connect the speaker to the cable and measure the impedance of each speaker line using a 1,000Hz signal applied to the line. The Contractor shall submit a list, to the Consultant, by cable number, of the impedance of each speaker line. This test shall be performed with the amplifier disconnected from the speaker line and the speaker connected to the speaker line.
   b. Verify all loudspeakers are working.
   c. Verify that the system meets all Performance Standards as outlined in 'Performance Standards'.
   d. Verify that all equipment, panels, and cables are labeled correctly.
   e. Verify each item of equipment is functioning as intended.
   f. Verify the installation is the same as specified.
   g. Loudspeaker Installation:
      1) Verify the aiming and positioning of all loudspeakers with the Consultant.
      2) If the Consultant has developed an EASE software model, obtain the coverage plots from the Consultant and confirm the performance of the loudspeaker system meets or exceeds the coverage indicated in such model.
   h. Microphone Installation:
      1) Verify proper positioning of all ceiling and table mounted microphoned
      2) Configure steerable microphone array lobes to provide uniform and even coverage of all areas designated as participant seating areas or presentation areas while avoiding

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areas susceptible to noise transmission such as HVAC registers, glass walls, doorways and divisible walls as required.

5. Additional Audio System Processing Adjustments
   a. Where applicable, the Contractor shall program the DSP system to include filters adjusted such that the loudspeaker zone(s) affected by same are measured to exhibit uniform (flat) frequency response (less than +/- 3 dB) at the listening location for the frequencies the transducer is designed/intended to address. The exception to this rule shall be in speech reinforcement systems where additional adjustments shall be made to ensure maximum gain with minimum feedback.
   b. Measurements utilized for determining filter adjustments shall be made on axis with respect to a single transducer (representative of the zone) in its intended field of coverage. Loudspeaker cross-over filters shall be provided first for all actively crossed transducers per loudspeaker manufacturer’s instructions. Additional filters will still be required to achieve uniform frequency response measured at the various listening locations.
   c. For loudspeaker zones of small transducers, utilize high-pass filters first and foremost and then utilize parametric EQ filters to flatten the measured response.
   d. For loudspeaker zones of large transducers, where other transducers in the system will address higher frequencies, utilize low-pass filters first and foremost and then utilize parametric EQ filters to flatten the measured response.
   e. The Contractor shall program the DSP system to include delay settings adjusted so that the direct sound from the main loudspeaker clusters and the delay zone transducers in question arrives simultaneously at the listening plane served by the delay zone transducers.
   f. The Consultant may request additional filters and delay (as required) to address 'tuning preferences', but such 'tuning preferences' shall not be considered as part of the base line requirements for determining substantial completion of the audio system. Flat frequency response and time alignment of the direct sound from the loudspeakers will be considered a base line requirement for determining substantial completion of the audio system.
   g. Dante Audio Network
      1) Configure Dante network within Dante Controller or if specified within the project, Dante Domain Manager labeling all devices as their product host names and labeling all utilized audio channels. All unused channels shall retain their respective channel number.
      2) Properly designate and configure a master clock source and latency settings.
      3) Route audio as required.
6. Computer Configuration – OFCI (Owner Furnished Contractor Installed)
   a. The Contractor shall be responsible for coordinating with the Owner regarding the specific requirements of Owner furnished computers and/or servers as applicable to meet the functional requirements of the audiovisual systems as specified.
   b. Coordination shall ensure that the computers and/or servers meet the recommended hardware configuration required by the Audiovisual Systems as well as for all software applications, including any software provided as part of this Specification, Owner furnished software integral to the functionality of the audiovisual system, and custom software that is developed through a 3rd-party for use within the audiovisual system.
   c. Contractor coordination with the Owner on the requirements of OFCI computers shall include but may not be limited to:
      1) Form factor
      2) Firmware

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3) Operating System (OS)
4) Memory
5) Hardware versus firmware, versus OS, versus software compatibility
6) Video output quantity and type
7) Audio output quantity and type
8) Network connection(s) quantity and type
9) USB port quantity and type
10) Power supply(s)
11) Display type, resolution, size and quantity
12) Peripherals, including but not limited to:
    a) Keyboard
    b) Mouse
    c) Cameras
    d) Microphones
    e) USB enabled devices
    f) Others as specified

d. The Contractor shall further coordinate with the Owner's IT department to:
    1) Install and configure the furnished computer hardware to function within the audiovisual system as intended by this Specification. This includes but is not limited to the configuration of the following:
        a) Display Settings
        b) Audio settings
        c) Network settings
        d) USB devices and drivers
        e) Others as specified
    2) Install and configure any software provided as part of this Specification.
    3) Configure any Owner provided software that is integral to the functionality of the audiovisual system.

e. The Contractor shall provide to the Owner a date by which all computers must be available to the Contractor for final installation and configuration.

7. Analog VGA Video, RGB Video, RGBS Video, RGBHV Video
    a. To establish that the facility cabling and terminations meet the specifications defined in 'Performance Standards', a video test signal shall be applied to each input cable and passed through the system switching and distribution networks with test patterns observed at each system display.
    b. Test signals shall be generated using an Extron VTG 400DVI programmable video and audio test generator (or equal).
    c. The following test patterns (at a minimum) shall be observed:
        1) Circles – no visible deviation from image geometry and linearity
        2) Safe area – no visible horizontal or vertical over or under scan
        3) Focus – proper image delineation in all areas
        4) Coarse Crosshatch – no vertical or horizontal bowing
        5) Fine Crosshatch – no vertical or horizontal bowing
        6) PLUGE – properly set black level (brightness) and display gain (contrast)
        7) 32-Level Split Grayscale – even transition from black to white, no color shift
        8) SMPTE Color Bars with PLUGE pattern – no color or pattern deviations

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9) Flat Field – uniform white field with no color, hot or dark spotting
10) Hum Bar Detect – no visible hum bars

9. DVI, HDMI, DisplayPort, Mini DisplayPort and Thunderbolt Digital Video
   a. To establish that the facility cabling and terminations meet the specifications defined in 'Performance Standards', a video test signal shall be applied to each input cable and passed through the system switching and distribution networks with test patterns observed at each system display.
   b. Test signals shall be generated using a Quantum Data 780 (or equal).
   c. Execute at a minimum, the following functional sink tests:
      1) HDCP verification
      2) EDID emulation
      3) Video pattern testing. The following test patterns (at a minimum) shall be observed:
         a) Circles – no visible deviation from image geometry and linearity
         b) Safe area – no visible horizontal or vertical over or under scan
         c) Focus – proper image delineation in all areas
         d) Coarse Crosshatch – no vertical or horizontal bowing
         e) Fine Crosshatch – no vertical or horizontal bowing
         f) PLUGE – properly set black level (brightness) and display gain (contrast)
         g) 32-Level Split Grayscale – even transition from black to white, no color shift
         h) SMPTE Color Bars with PLUGE pattern – no color or pattern deviations
         i) Flat Field – uniform white field with no color, hot or dark spotting
         j) Hum Bar Detect – no visible hum bars
   d. Execute at a minimum, the following functional source tests:
      1) Status bar showing HDMI In
      2) View incoming video
      3) Monitor incoming audio
      4) EDID emulation
10. High-Bandwidth Digital Content Protection (HDCP)
   a. Use a Quantum Data QD-882EA video test generator or similar to verify a "Pass" test that HDCP is performing to specification for source tests using a sink emulator and/or protocol analyzer; and sink devices using source emulators or protocol generators including the following parameters:
      1) Protocol adherence
      2) Audio/Video Format Switching
      3) Media Switching
      4) Force AVMUTE
      5) Link Integrity (Pj) Check Repeat Rate
      6) Pj Mismatch Response
      7) Number of Keys (source test with sink emulator)
11. Extended Display Identification Data (EDID)
   a. The Contractor shall ensure that all devices capable of generating or accepting EDID information have been updated with the latest version of the EDID standard.
   b. The Contractor shall modify all EDID tables to ensure that the highest common resolution is used by each device within a given system.

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c. The Contractor shall modify the EDID tables to include the most common computer/laptop resolutions used within the facility. Coordination with the Owner shall be required.
d. The Contractor shall ensure that EDID information is maintained thought the signal chain and that intermediary devices that pass or modify the EDID information conform to the other requirements stated within this Specification.

12. Computer / Video Display Devices
    a. The Contractor shall optimize display equipment for the following minimum standard scan rates and resolutions:
        1) NTSC / 480p
        2) HDTV: 720p/60, 1080i/60 and 1080p/60
        3) FHD: 1920 x 1080, 60 Hz
        4) WUXGA: 1920 x 1200, 60 Hz.
        5) UHD: 3840 X 2160, 60 Hz.
        6) 4K: 4096 X 2160, 60 Hz.
13. Control
    a. Upon completion of installation, the Contractor shall test each function of each control station, push-button panel, touch screen panel, computer control interface, and all components connected to or interfaced to the Control System to verify proper operation and that each switch and indicator operates as intended.
14. Systems Overview
    a. In addition, the Contractor shall:
        1) Verify each item of equipment is functioning as intended.
        2) Verify the installation is the same as specified.

END OF SECTION 274116

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SECTION 274116.02 – AUDIOVISUAL SYSTEMS APPENDICES

PART 1 - APPENDIX A

1.1 LIST OF DRAWINGS

A. Refer to drawing sheet AVS00 for sheet index of provided drawings.

B. Audiovisual Infrastructure Reference Drawings have been included for the Bidders reference in bidding the work called for by the Contract Documents. Reference drawings may not reflect as-built conditions. It shall be the responsibility of the Contractor to field verify all site conditions.

PART 2 - APPENDIX B

2.1 SUMMARY OF AUDIOVISUAL SYSTEMS SUBMITTALS

Description	Deadline
Request for Information (Pre-Bid)	Per Owner documentation
Bonds	Per Owner documentation
Line item pricing	With Bid Response
Contractor Qualifications	Per Section 274116
Substitution Requests	Per Section 274116
Schedule	Within 15 days of notification of contract award
Submittal Log	Per Contractor's published schedule
Progress Reports	While working off-site: every two weeks While working on-site: every week.
Shop Drawings	Prior to equipment and materials purchase, fabrication, or installation
Bill of Materials	Prior to equipment and materials purchase, fabrication, or installation
Equipment Rack Digital Photographs	Prior to delivering racks to the project site
Audio Digital Signal Processing (DSP)	Per Contractor's published schedule
Control System Control Surfaces / GUI Prototype submittal	Per Contractor's published schedule
Control System Control Surfaces/GUI Submittal	Per Contractor's published schedule
Preliminary As-Built Drawing Submittal	Prior to Final Testing and System Performance Verification
Final Documentation	Within 30 days of Substantial Completion
Post-Integration Control Surfaces Adjustments	Within 90 days of Substantial Completion

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PART 3 - APPENDIX C: PRE-BID FORMS

3.1 CONTRACTOR QUALIFICATION REQUIREMENTS

Corporate Profile

Location of Corporate Headquarters	
Number of Offices & Locations	
Location of Office Assigned to this Project	

Corporate History

Number of Years in Business	
Any Former Names of the Organization	
Date(s) of Incorporation	
State of Incorporation	
Officer Names & Addresses	

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Litigation Experiences (Last 5 Years)

Project Related	
Nature of Litigation	
Plaintiff or Defendant	
Outcome	
Non-Project Related	
Nature of Litigation	
Plaintiff or Defendant	
Outcome	

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Financial

Trade & Bank References (List 3)	
Dunn & Bradstreet Ranking	
Insurance Limits	
Name of Bonding Company	
Name & Address of Agent	
Maximum Bonding Capacity	
Current Bonding Capacity	
Performance Bond Ever Exercised?	

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Staffing

Total Number of Employees	
Number of Design Staff	
Number of Installation Staff	
Number of Project Management Staff	
Number of Software Programming Staff	

Project Key Personnel

Project Executive	
Project Manager	
Systems Engineer/Designer	
Lead Installer	
Control Systems Programmer	
Audio DSP Programmer	
Commissioning Agent	
Trainer	

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Project Executive Resume

Name	
Office Location	
Percentage of Individual's Time Allocated to this Project	
Work History	
Previous Project Experience	
Length of Employment	
Certifications	☐ CTS ☐ CTS-D ☐ CTS-I ☐ RCDD ☐ PMP ☐ Certified Control System Programmer ☐ Certified DSP Programmer ☐ Others

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Project Manager Resume

Name	
Office Location	
Percentage of Individual's Time Allocated to this Project	
Work History	
Previous Project Experience*	
Length of Employment	
Certifications	☐ CTS ☐ CTS-D ☐ CTS-I ☐ RCDD ☐ PMP ☐ Certified Control System Programmer ☐ Certified DSP Programmer ☐ Others

* The assigned Project Manager shall have at least 5 years experience with audiovisual projects of similar scope & scale.

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Systems Engineer/Designer Resume

Name	
Office Location	
Percentage of Individual's Time Allocated to this Project	
Work History	
Previous Project Experience*	
Length of Employment	
Certifications	☐ CTS ☐ CTS-D ☐ CTS-I ☐ RCDD ☐ PMP ☐ Certified Control System Programmer ☐ Certified DSP Programmer ☐ Others
Extron NAV certification number and expiration date	

* The assigned Systems Engineer/Designer shall have at least 5 years experience with audiovisual projects of similar scope & scale.

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Lead Installer Resume

Name	
Office Location	
Percentage of Individual's Time Allocated to this Project	
Work History	
Previous Project Experience*	
Length of Employment	
Certifications	☐ CTS ☐ CTS-D ☐ CTS-I ☐ RCDD ☐ PMP ☐ Certified Control System Programmer ☐ Certified DSP Programmer ☐ Others
AVIXA/InfoComm International CTS-I certification, number and expiration date	
Extron NAV certification number and expiration date	

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Control Systems Programmer Resume

Name	
Office Location	
Percentage of Individual's Time Allocated to this Project	
Work History	
Previous Project Experience*	
Length of Employment	
Certifications	☐ CTS ☐ CTS-D ☐ CTS-I ☐ RCDD ☐ PMP ☐ Certified Control System Programmer ☐ Certified DSP Programmer ☐ Others
Extron NAV Programming certification number and expiration date	

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Audio DSP Programmer Resume

Name	
Office Location	
Percentage of Individual's Time Allocated to this Project	
Work History	
Previous Project Experience*	
Length of Employment	
Certifications	☐ CTS ☐ CTS-D ☐ CTS-I ☐ RCDD ☐ PMP ☐ Certified Control System Programmer ☐ Certified DSP Programmer ☐ Others
QSC Q-SYS Level Two Training, certification number and expiration date	

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Commissioning Agent Resume

Name	
Office Location	
Percentage of Individual's Time Allocated to this Project	
Work History	
Previous Project Experience	
Length of Employment	
Certifications	☐ CTS ☐ CTS-D ☐ CTS-I ☐ RCDD ☐ PMP ☐ Certified Control System Programmer ☐ Certified DSP Programmer ☐ Others

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Trainer Resume

Name	
Office Location	
Percentage of Individual's Time Allocated to this Project	
Work History	
Previous Project Experience	
Length of Employment	
Certifications	☐ CTS ☐ CTS-D ☐ CTS-I ☐ RCDD ☐ PMP ☐ Certified Control System Programmer ☐ Certified DSP Programmer ☐ Others

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Resources

Manufacturers' Line Card for products Company is an authorized distributor or dealer. Include authorization date	Provide this as an attachment
List of Manufacturers' Technical Certifications or Designations	
List of Manufacturers' for Whom the Company is an Authorized Service Center	Provide this as an attachment
List of Computer Software and/or Systems that Will Be Used on the Project	
List of Contractor Owned Test Equipment. Include Manufacturer, Model, and Software Version	

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References – Three Projects

1. Project Reference 1:

Institute and Project Name	
Contact Name	
Phone Number	
E-Mail Address	
Similar Scope & Scale	
Similar Technology Application	
Project Costs	

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2. Project Reference 2:

Institute and Project Name	
Contact Name	
Phone Number	
E-Mail Address	
Similar Scope & Scale	
Similar Technology Application	
Project Costs	

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3. Project Reference 3:

Institute and Project Name	
Contact Name	
Phone Number	
E-Mail Address	
Similar Scope & Scale	
Similar Technology Application	
Project Costs	

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List Any Previous Projects with Van Buren Township, NV5, or Fishbeck.	

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3.2 REQUEST FOR INFORMATION FORM

A. Bidders requesting information shall utilize this process and form. No verbal questions or phone communications shall be permitted during bid process.

B. All requests for information shall be submitted to the Owner and Consultant via e-mail.

Bidder _____

Name / Title _____

Date_____

E-mail Address_____

Phone / Fax _____

Spec Section/Article # _____

Drawing # _____

Detailed question:

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3.3 SUBSTITUTION REQUEST FORM

A. Bidders proposing product substitutions shall utilize this form. No verbal requests or phone communications shall be permitted during bid process.

B. All substitution requests shall adhere to the procedures and policies defined herein.

C. In addition to this form, all requests shall include cut sheets, drawings, performance data and other information necessary to demonstrate that the substitution will meet all intentions of this Specification or required for a complete evaluation.

D. All substitution requests shall be submitted to the Owner and Consultant via e-mail.

Bidder _____

Name / Title _____

Date_____

E-mail Address_____

Phone _____

Drawing # _____

System Type/Item #___ _____

Originally Specified item: _____

Requested Substitution: _____

Description:

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3.4 BID RESPONSE FORM

A. The Bidder shall complete and return this form. This document, as well as all submittals outlined herein, shall be considered to be the bid.

B. The Bidder shall provide line item pricing for all equipment as an attachment. All pricing is to be inclusive of any applicable taxes, shipping, handling, expenses, insurance or other miscellaneous charges.

Bid Form **Van Buren Township - The Lake House**	
	Totals
BASE BID	
Equipment and Materials	$
Shop Drawings and Submittals	$
In-Shop Fabrication Labor	$
On-Site Installation Labor	$
Software Development	$
Final Testing and Systems Performance Verification	$
Training and Closeout Documentation	$
Project Management and Coordination	$
Freight & General Administration	$
Year One Warranty	$
SUBTOTAL:	$
Applicable Taxes	$
BASE BID TOTAL:	$
Additional Warranties	
Year Two Warranty	$
Year Three Warranty	$
Year Four Warranty	$
Hourly Rates for Additional Work	**Per Hour Rates**
Project Engineer/Designer	$
Project Manager	$
Technician	$
Programmer	$
Trainer	$

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Bid Form

Van Buren Township - The Lake House

Bidder Company Name: _____

Authorized Signature: _____

Print Name: _____

Date: _____

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PART 4 - APPENDIX D: POST-AWARD FORMS

4.1 REQUEST FOR INFORMATION FORM

RFI #:		**Date:**	
To:		**From:**	
Specification Section / Article:		**Drawing # / Detail:**	
System Type:		**Room name / #:**	

Request:

Response by:		**Date:**	

Response:

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4.2 SUBSTITUTION REQUEST FORM

A. Post-award substitution requests shall utilize this form.

B. In addition to this form, all requests shall include drawings, performance and test data, and other information necessary to demonstrate that the substitution will meet all intentions of the Specification or required for a complete evaluation.

C. All substitution requests shall be submitted to the Owner and Consultant via e-mail.

Date_____

Drawing # _____

System Type/Item #_____

Originally Specified item: _____

Requested Substitution: _____

Cost impact/Credit to Owner: _____

Description/reason for post-award substitution request:

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4.3 PROGRESS REPORT FORM

Project Name:	
Date:	
From:	

Progress (Tasks accomplished since the previous report; both completed tasks and work-in-progress.)

Work Planned (Tasks scheduled for the time period extending until the next report)

Issues (Factors delaying progress or have the potential to delay progress involving the Owner, Architect and/or Consultant.)

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4.4 SUBMITTAL TRANSMITTAL FORM

Contractor:	
Project:	

This form shall accompany all Contractor Submittals.

The Contractor requests a review of the project Submittals as required by the project Specifications. By signing this form and returning it to the Consultant, the Contractor indicates that:

1. The Submittal documentation provided adheres to all requirements within the Specifications, including Specification Section 274116 “Scope of Work” and “Submittals.”
2. Unless otherwise approved, all required Submittals are included within as a single submission.
3. The Contractor shall provide final complete and detailed designs, as well as complete and operational systems, based on the design intent outlined in the Specification. Any omissions, discrepancies, substitutions, or exceptions to the Specification identified by the Contractor shall be communicated to the Consultant as part of this Submittal.
4. After completion of the Submittals process, the Contractor shall assume full responsibility for supplying complete and operational systems and final complete and detailed designs without claim for additional compensation. This shall include providing all equipment, Installation Materials, and labor needed to provide complete and operable system(s), even if such equipment, materials, or labor are not listed within this Specification, including the Bidding Equipment Lists.
5. After completion of the Submittals process, requests for additional compensation will only be considered based on the following conditions: Owner-requested changes, unexpected field issues due to work by other contractors, or schedule changes initiated by others.

Any incomplete items, deviations, or exceptions to the requirements of the Audiovisual Systems Specification shall be listed by the Contractor below, or provided as an attachment:

By signing below, Contractor verifies that the Submittal documentation is complete and accepts the conditions of this agreement.

Signature: _____ Print Name: _____

Title: _____Date: _____

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4.5 SYSTEMS PERFORMANCE VERIFICATION REQUEST FORM

Contractor:	
Project:	

The Contractor requests a Systems Performance Verification appointment by completing this form and returning it to NV5. By signing below, the Contractor indicates that

1. The work on this contract, as defined in the Audiovisual Systems Specification, is complete and ready for the Consultant's final Systems Performance Verification.
2. All required field tests have been performed and project documentation is on-site.
3. A computer/video signal generator or generators, capable of outputting all signal types included in the system designs, will be available onsite at the time of Systems Performance Verification.
4. Physical media (Blu-Ray disc, etc.) will be available onsite to verify the performance of all applicable source devices.

Any incomplete items, deviations, or exceptions to the requirements of the Audiovisual Systems Specification shall be listed by the Contractor below, or provided as an attachment:

If the Contractor's work is found to be incomplete, and subsequent visits to the site by the Consultant are required by the Owner, the Owner may elect to have the Consultant's travel costs, billable time, and all other related travel expenses be deducted from the Contractor's final payment.

By signing below, Contractor verifies that the job site is ready for final Systems Performance Verification and accepts the conditions of this agreement.

Signature: _____ Print Name: _____

Title: _____Date: _____

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PART 5 - APPENDIX E: BIDDING EQUIPMENT LISTS

5.1 BIDDING EQUIPMENT LISTS

A. Bidding Equipment Lists can be found on the following pages.

B. Bidding Equipment Lists show quantities per room. The quantity of rooms for each system type is listed at the top of each page.

C. Bidding Equipment Lists include manufacturers and model numbers where appropriate. Additional identification or ordering information may vary according to supplier, and the Bidder shall cross-reference with an individual supplier if required.

5.2 MASTER QUOTE NUMBERS

A. As a convenience to the Contractor in preparing the bid response, Master Quote numbers have been provided for several equipment groups. Where given, Master Quote numbers or other quotation numbers have been provided for bidding purposes only. It shall be the responsibility of the Contactor to verify that they have received the latest versions of the Master Quotes prior to bidding, and to establish the accuracy of the quotes prior to ordering.

5.3 LIST OF BRAND SPECIFIC PRODUCTS

A. Some manufacturer's names and product descriptions used in this specification are product specific with no substitutions allowed. The items listed as “Brand Specific” in this specification must be the manufacturer and type specified. These specific products are required for compatibility with the Owner’s existing systems and to maintain continuity of support. The Brand Specific Products as specified for this project include those by:

1. Extron

5.4 KEYED BIDDING NOTES

A. OFCI (Other Furnished Contractor Installed)

B. OFOI (Other Furnished Other Installed, or Provided by Others)

C. Included with above package

D. Coordinate stock color/finish with architect

E. Custom painted. Coordinate with architect

F. Field verify prior to submittals

G. Special or noteworthy installation requirements – Refer to System Description for details

H. Reference manufacturer’s Master Quote

END OF SECTION 274116.02

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Van Buren Township
The Lake House

100% Audiovisual Systems

Bidding Equipment List

*See 274116 Appendices

Number : **169 / 170 / 164**

Type : **SY01**

Name : **Ballroom**

Rm Qty : **1**

ID	Manufacturer	Model	Item / Description	Unit Qty	Bidding Notes*
Display Surfaces					
1	Generic	Projection Screen	Projection Screen per Infrastructure Reference Drawings (OFOI)	2	B
Display Devices					
2	Epson	EB-PU1008x	8,500 Lumens, 3LCD, Laser Light Projector, WUXGA w/ 4K Enhancement, Lens Not Included	2	D
3	Contractor Select	Zoom Lens	Projector Lens for Above	2	F
4	Chief	Projector Ceiling Mount	Contractor Selected Projector Ceiling Mount	2	-
5	Chief	Projector Mounting Hardware	Contractor Selected Projector Mounting Hardware as Needed	2	-
6	Contractor Select	Projector Extension Column	Projector Extension Column for Above	2	F
7	Samsung	QM55C	55" Professional LED Edge-Lit Display w/ Built-In Speakers, 3840 x 2160 Native	2	-
8	Chief	MFQUx	Medium Confidence Monitor Cart 2'	2	-
Source Devices					
9	Extron	Sharelink Pro 2000 w/ Miracast	4K Wireless Presentation System w/ Miracast & ShareNext - US	2	-
10	BrightSign	XT244	4K H.265/H.264 Standard I/O Player	1	-
Video Capture, Streaming and Conferencing					
11	Vaddio	RoboShot 20 UHD OneLink HDMI	UHD PTZ Camera - 12x Optical / 20x Digital Zoom - 74 Deg. FOV - HD-SDI/Network/HDBT/HDMI Outputs PoE++ - 2160p/30 Native	2	-
12	Extron	MediaPort 300	4K HDMI and Audio to USB Scaling Bridge	2	-
Signal Processing, Routing, and Distribution					
13	Extron	DTP3 T 322 D	Two Input 4K/60 DTP3 Transmitter for HDMI and USB-C with Data – Decorator-Style Wallplate	2	D
14	Extron	DTP3 R 331	DTP3 Receiver for 4K/60 HDMI and USB Data	2	-
15	Extron	UPI 100	100 Watt Power Inserter for Extron USB-C Products	2	-
16	Extron	NAV E 501	1G Pro AV over IP Encoder - HDMI, Ethernet, and USB	2	H
17	Extron	NAV E 121	1G Pro AV over IP Compact Encoder - HDMI	7	-
18	Extron	NAV SD 121	1G Pro AV over IP Compact Scaling Decoder - HDMI	4	-
19	Extron	NAV SD 501	1G Pro AV over IP Scaling Decoder - HDMI, Ethernet, and USB	2	H
20	Extron	NAVigator	Pro AV over IP System Manager, 16 Endpoints	1	H
21	Netgear	M4250-40G8XF-PoE++	40 Port, 1G Ports, PoE++ (720/1650/2880W), (8) 10G SFP, 240 Gbps, AV Line Managed Network Switch	1	-

Van Buren Township
The Lake House

100% Audiovisual Systems

Bidding Equipment List

*See 274116 Appendices

Number : **169 / 170 / 164**

Type : **SY01**

Name : **Ballroom**

Rm Qty : **1**

ID	Manufacturer	Model	Item / Description	Unit Qty	Bidding Notes*
Speech Reinforcement System/Audio Conferencing					
22	Extron	DMP 128 Plus C AT	12x8 ProDSP Digital Matrix Audio Processor w/ USB Audio, Dante, and AEC	1	-
23	Shure	ULXD4Q	Quad Channel Digital Wireless Receiver	1	F
24	Contractor Select	Antenna Distribution	Contractor Select Antenna Distribution Systems	1	-
25	Shure	ULXD1	Wireless Bodypack Transmitter w/ On/Off Switch and LED Status, TQG Connector (Black Only)	2	F
26	Shure	WL185	Cardioid Lavalier Microphone	2	-
27	Shure	ULXD2/B58	Handheld Digital Wireless Microphone Transmitter w/ Beta 58 Cartridge	2	F
28	Shure	SB900C	Rechargeable Lithium-Ion Battery	4	-
29	Shure	SBRC-US	8-Bay Battery Rack Charger (SB900A)	1	-
Sound Reinforcement System					
30	Extron	NETPA U 2004 FX	4-CH, 200W @ 70V/8Ohm/4Ohm Amplifier with Local and Dante Inputs, Integrated DSP	1	-
31	QSC	AD-C6T-xx	6" 2-Way Ceiling Speaker, Weather-Resistant, w/70V/100V transformer & 8Ohm Bypass	21	D
32	Listen Technologies	LW-170-02-09	Listen Everywhere 2 Channel Server, Dante	1	-
33	Listen Technologies	LA-480-01	16 Unit Docking / Charging Station	1	-
34	Listen Technologies	LA-438	Advanced Neck Loop (Adult)	2	-
35	Listen Technologies	LW-307	ListenWIFI Hearing Assistance Signage	1	-
36	Listen Technologies	LWR-1020	Listen EVERYWHERE Wi-Fi Audio Receiver 1020	7	-
37	Listen Technologies	LA-401	Universal Ear Speaker	7	-
38	Listen Technologies	LA-326	Universal Rack Mounting Kit	1	-
Control System					
39	Extron	IPCP Pro 360Q xi	IP Link Pro Processor, Quad Core, (3) RS-232, (4) Relay, (4) I/O, Lan, (3) AV Lan Ports	1	-
40	Extron	TLP Pro 1035M	10.1" Wall Mount TouchLink Pro Touchpanel (Select Color)	2	D
41	Extron	TLP Pro 1035T	10.1" Tabletop TouchLink Pro Touchpanel (Select Color)	2	D
42	AV Contractor Select	Partition Sensor	Contractor Selected Partition Sensor	1	-

Van Buren Township
The Lake House

100% Audiovisual Systems

Bidding Equipment List

*See 274116 Appendices

ID	Manufacturer	Model	Item / Description	Unit Qty	Bidding Notes*

Number : **169 / 170 / 164**

Type : **SY01**

Name : **Ballroom**

Rm Qty : **1**

Rack, Panels, Misc.

43	Middle Atlantic	L2	Pre-Configured Lectern, 28" W x 25" D. With AV Connectivity and Flip Up Shelf	2	D
44	Middle Atlantic	BGR-4532-AV	BGR-Series 45RU, 32"D Equipment Rack Pre-Configured For AV	1	-
45	Middle Atlantic	PDX-920R-SP	NEXSYS 9 Outlet, 20 Amp Rackmount Power with Series Surge Protection	1	-
46	Middle Atlantic	PDT-1620C-NS	Vertical Power Distribution Strip, (16) Outlets, 20A	1	-
47	RCI Custom	NV5001-250217MM-02	Shared Credit Rack ID Panel with RJ45 Passthrough	1	-
48			Installation Materials as Defined in AV Systems Specification	Lot	
49			Custom Wall/Floor Box and Decorator-Style Plates as Needed	Lot	
50			Pre-Made Loose Cabling and Field Cabling as Needed	Lot	
51			Rack Panels, Vents, Mounts, Shelves, Other Rack Materials as Needed	Lot	
52			Rack ID Panels per Specification, See AV Rack Accessories	Lot	
53			Wall, Ceiling Mounts and Mounting Hardware as Needed	Lot	
54			Control System Accessories as Needed	Lot	
55			Power Supplies and Power Distribution as Needed	Lot	
56			Cable Terminations, Cable Dressing, Labels, Ties, Cable Management as Needed	Lot	

End of System

Van Buren Township
The Lake House

100% Audiovisual Systems

Bidding Equipment List

*See 274116 Appendices

Number : **104 / 105**

Type : **SY02**

Name : **Community Living Room / Multi-Purpose Room**

Rm Qty : **1**

ID	Manufacturer	Model	Item / Description	Unit Qty	Bidding Notes*
Display Devices					
1	Samsung	QM98x	98" Professional LED Edge-Lit Display w/Built-In Speakers, 3840x2160 Native (Latest Model)	2	-
2	Chief	Wall Mount	Contractor Selected Flat Panel Display Wall Mount	2	-
3	Samsung	QM55C	55" Professional LED Edge-Lit Display w/ Built-In Speakers, 3840 x 2160 Native	1	-
4	Chief	AS3LDP7	Tempo™ Flat Panel Wall Mount System w/ PDU	1	-
Source Devices					
5	Extron	Sharelink Pro 2000 w/ Miracast	4K Wireless Presentation System w/ Miracast & ShareNext - US	3	-
6	Extron	Cable Cubby 202	Cable Enclosure, Flip Top, Basic, (1) AC & Cable Pass Through Bracket	1	-
7	Extron	Cable Enclosure Inserts	Inserts And Blank Plates For Above - Refer To System Diagram For Details	1	-
8	Extron	Cable Enclosure Accessories	Accessories For Above As Required (e.g. Cloaks, Brackets, Etc)	1	-
Video Capture, Streaming and Conferencing					
9	Vaddio	RoboShot 20 UHD OneLink HDMI	UHD PTZ Camera - 12x Optical / 20x Digital Zoom - 74 Deg. FOV - HD-SDI/Network/HDBT/HDMI Outputs PoE++ - 2160p/30 Native	2	-
10	Extron	MediaPort 300	4K HDMI and Audio to USB Scaling Bridge	1	-
Signal Processing, Routing, and Distribution					
11	Extron	NAV E 222	1G Pro AV Over IP Encoder with USB-C and HDMI	1	-
12	Extron	UPI 100	100 Watt Power Inserter for Extron USB-C Products	1	-
13	Extron	NAV E 121	1G Pro AV over IP Compact Encoder - HDMI	5	-
14	Extron	NAV SD 121	1G Pro AV over IP Compact Scaling Decoder - HDMI	3	-
15	Extron	NAV SD 501	1G Pro AV over IP Scaling Decoder - HDMI, Ethernet, and USB	1	H
16	Extron	NAV E 111 DTP3	1G Pro AV over IP Encoder with DTP3 Input	1	H
17	Extron	DTP3 T 212 D	Two Input 4K/60 DTP3 Transmitter for USB-C and HDMI – Decorator-Style Wallplate, 18 Gbps	1	D
18	Extron	NAVigator	Pro AV over IP System Manager, 16 Endpoints	1	H
19	Netgear	M4250-40G8XF-PoE++	40 Port, 1G Ports, PoE++ (720/1650/2880W), (8) 10G SFP, 240 Gbps, AV Line Managed Network Switch	1	-
Speech Reinforcement System/Audio Conferencing					
20	Extron	DMP 64 Plus C AT	6x4 Digital Matrix Processor w/ AEC and Dante	1	-
21	Shure	MXA925x-R	Ceiling Array Microphone & Integrated Loudspeaker w/ Dante, PoE+, Round	2	D
22	Shure	ULXD4Q	Quad Channel Digital Wireless Receiver	1	F
23	Shure	ULXD1	Wireless Bodypack Transmitter w/ On/Off Switch and LED Status, TQG Connector (Black Only)	1	F
24	Shure	WL185	Cardioid Lavalier Microphone	1	-
25	Shure	ULXD2/B58	Handheld Digital Wireless Microphone Transmitter w/ Beta 58 Cartridge	1	F
26	Shure	SB900C	Rechargeable Lithium-Ion Battery	2	-
27	Shure	SBRC-US	8-Bay Battery Rack Charger (SB900A)	1	-

Van Buren Township
The Lake House

100% Audiovisual Systems

Bidding Equipment List

*See 274116 Appendices

Number : **104 / 105**

Type : **SY02**

Name : **Community Living Room / Multi-Purpose Room**

Rm Qty : **1**

ID	Manufacturer	Model	Item / Description	Unit Qty	Bidding Notes*
Sound Reinforcement System					
28	Extron	NetPA U 1004-70V	4-CH, 100W @ 70V Amplifier with Local and Dante Inputs, Integrated DSP	1	-
29	QSC	AD-C6T-xx	6" 2-Way Ceiling Speaker, Weather-Resistant, w/70V/100V transformer & 8Ohm Bypass	16	D
30	Listen Technologies	LW-170-02-09	Listen Everywhere 2 Channel Server, Dante	1	-
31	Listen Technologies	LA-423	4-Port USB Charger For Use w/ Assisted Listening Receivers	1	-
32	Listen Technologies	LA-438	Advanced Neck Loop (Adult)	2	-
33	Listen Technologies	LW-307	ListenWIFI Hearing Assistance Signage	1	-
34	Listen Technologies	LWR-1020	Listen EVERYWHERE Wi-Fi Audio Receiver 1020	2	-
35	Listen Technologies	LA-401	Universal Ear Speaker	2	-
36	Listen Technologies	LA-326	Universal Rack Mounting Kit	1	-
Control System					
37	Extron	IPCP Pro 255Q xi	IP Link Pro Control Processor, Quad Core, (1) Bidirectional RS-232 Serial Port, (1) Bidirectional RS-232/RS-422/RS-485 Serial port, (1) IR/Serial Port, (4) Digital I/O ports, (2) Relays, Dual NIC	1	-
38	Extron	TLP Pro 1035M	10.1" Wall Mount TouchLink Pro Touchpanel (Select Color)	1	D
39	Extron	TLP Pro 1035T	10.1" Tabletop TouchLink Pro Touchpanel (Select Color)	1	D
40	AV Contractor Select	Partition Sensor	Contractor Selected Partition Sensor	1	-
Rack, Panels, Misc.					
41	Middle Atlantic	C5-FF27-2	C5-Series Frame, (2) Bay, 27"D	1	-
42	Middle Atlantic	C5K2A1xxx	C5 Wood Kit 2-Bay 27"D 32"H	1	D
43	Middle Atlantic	PDX-920R-SP	NEXSYS 9 Outlet, 20 Amp Rackmount Power with Series Surge Protection	2	-
44	RCI Custom	NV5001-250217MM-02	Shared Credit Rack ID Panel with RJ45 Passthrough	1	-
45			Installation Materials as Defined in AV Systems Specification	Lot	
46			Custom Wall/Floor Box and Decorator-Style Plates as Needed	Lot	
47			Pre-Made Loose Cabling and Field Cabling as Needed	Lot	
48			Rack Panels, Vents, Mounts, Shelves, Other Rack Materials as Needed	Lot	
49			Rack ID Panels per Specification, See AV Rack Accessories	Lot	
50			Wall, Ceiling Mounts and Mounting Hardware as Needed	Lot	
51			Control System Accessories as Needed	Lot	
52			Power Supplies and Power Distribution as Needed	Lot	
53			Cable Terminations, Cable Dressing, Labels, Ties, Cable Management as Needed	Lot	

End of System

Van Buren Township
The Lake House

100% Audiovisual Systems

Bidding Equipment List

*See 274116 Appendices

Number : **118**
Type : **SY03**
Name : **Meeting Room**
Rm Qty : **1**

ID	Manufacturer	Model	Item / Description	Unit Qty	Bidding Notes*
Display Devices					
1	Samsung	QM65x	65" Professional LED Edge-Lit Display w/Built-In Speakers, 3840x2160 Native (Latest Model)	1	-
2	Chief	AS3LDP7	Tempo™ Flat Panel Wall Mount System w/ PDU	1	-
Source Devices					
3	Extron	Sharelink Pro 2000 w/ Miracast	4K Wireless Presentation System w/ Miracast & ShareNext - US	1	-
4	Extron	Cable Cubby 202	Cable Enclosure, Flip Top, Basic, (1) AC & Cable Pass Through Bracket	1	-
5	Extron	Cable Enclosure Inserts	Inserts And Blank Plates For Above - Refer To System Diagram For Details	1	-
6	Extron	Cable Enclosure Accessories	Accessories For Above As Required (e.g. Cloaks, Brackets, Etc)	1	-
Video Capture, Streaming and Conferencing					
7	Logitech	Rally Bar	All-In-One Video Bar w/ Camera, Speakers, and Beamforming Microphone	1	D
Signal Processing, Routing, and Distribution					
8	Extron	DTP3 T 321	4K/60 USB-C DTP3 Transmitter with Data and Power Delivery	1	-
9	Extron	DTP3 R 331	DTP3 Receiver for 4K/60 HDMI and USB Data	1	-
10	Extron	UPI 100	100 Watt Power Inserter for Extron USB-C Products	1	-
Control System					
11	Extron	IPCP Pro 255Q xi	IP Link Pro Control Processor, Quad Core, (1) Bidirectional RS-232 Serial Port, (1) Bidirectional RS-232/RS-422/RS-485 Serial port, (1) IR/Serial Port, (4) Digital I/O ports, (2) Relays, Dual NIC	1	-
12	Extron	TLP Pro 1035T	10.1" Tabletop TouchLink Pro Touchpanel (Select Color)	1	D
Rack, Panels, Misc.					
13			Installation Materials as Defined in AV Systems Specification	Lot	
14			Custom Wall/Floor Box and Decorator-Style Plates as Needed	Lot	
15			Pre-Made Loose Cabling and Field Cabling as Needed	Lot	
16			Rack Panels, Vents, Mounts, Shelves, Other Rack Materials as Needed	Lot	
17			Rack ID Panels per Specification, See AV Rack Accessories	Lot	
18			Wall, Ceiling Mounts and Mounting Hardware as Needed	Lot	
19			Control System Accessories as Needed	Lot	
20			Power Supplies and Power Distribution as Needed	Lot	
21			Cable Terminations, Cable Dressing, Labels, Ties, Cable Management as Needed	Lot	
End of System					

Van Buren Township
The Lake House

100% Audiovisual Systems

Bidding Equipment List

*See 274116 Appendices

ID	Manufacturer	Model	Item / Description	Unit Qty	Bidding Notes*

Number : **N/A**

Type : **SY04**

Name : **Outdoor Sound System**

Rm Qty : **1**

Source Devices					
1	Owner Furnished	DMP	Digital Media Player (OFCI)	1	A
Sound Reinforcement System					
2	Extron	NetPA U 2008 FX	8-Ch, Configurable Output Dante Amp, 200 watts,	1	-
3	QSC	AD-S8T-xx	8" Two-Way Wall-Mounted Speaker w/ 70V/100V Transformer & 8Ohm Bypass, Includes Mounting Hardware.	5	D
4	Contractor Select	Wall Mount	Contractor Selected Wall Mount For Above	5	-
Control System					
5	Extron	TLP Pro 835T	8" Tabletop TouchLink Pro Touchpanel (Select Color)	1	D
Rack, Panels, Misc.					
6			Installation Materials as Defined in AV Systems Specification	Lot	
7			Custom Wall/Floor Box and Decorator-Style Plates as Needed	Lot	
8			Pre-Made Loose Cabling and Field Cabling as Needed	Lot	
9			Rack Panels, Vents, Mounts, Shelves, Other Rack Materials as Needed	Lot	
10			Rack ID Panels per Specification, See AV Rack Accessories	Lot	
11			Wall, Ceiling Mounts and Mounting Hardware as Needed	Lot	
12			Control System Accessories as Needed	Lot	
13			Power Supplies and Power Distribution as Needed	Lot	
14			Cable Terminations, Cable Dressing, Labels, Ties, Cable Management as Needed	Lot	

End of System

SECTION 280000 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.

B. This section is inclusive to all Division 28 sections.

C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

1.2 SUMMARY

A. This project consists of providing a complete Electronic Safety and Security System for the New Community Center in Van Buren Township. The electronic safety and security system includes access control, intrusion detection, surveillance, and emergency phone locations as shown on the drawings and shall be connected to the campus headend.

B. This Section includes general administrative and procedural requirements for the electronic safety and security systems. It includes Contractor qualifications, terminations, and testing parameters. Reference individual sections for further expansion of these requirements.

C. Permits, Inspections, Codes and Regulatory References

1. General: Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Technology Consultant.

2. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable with electronic and electrical installations.

3. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

4. This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

1.3 ABBREVIATIONS AND DEFINITIONS

A. General: In addition to abbreviations defined in Division 1, utilize the following abbreviations and definitions for discernment with the Drawings and Specifications.

B. Abbreviations:

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1. NEC: National Electrical Code
2. OSHA: Occupational Safety and Health Administration
3. ANSI: American National Standards Institute
4. ASIS: American Society for Industrial Security
5. NFPA: National Fire Protection Association
6. ASA: American Standards Association
7. IEEE: Institute of Electrical and Electronics Engineers
8. NEMA: National Electrical Manufacturers Association
9. UL: Underwriter's Laboratories, Inc.
10. ICEA: International Cable Engineers Association
11. ASTM: American Society of Testing Materials
12. ETL: Electrical Testing Laboratories, Inc.
13. TIA: Telecommunications Industry Association
14. ICIA: International Communications Industries Association
15. OEM: Original Equipment Manufacturers
16. EC: Electrical Contractor
17. SCC: Structured Cable Contractor
18. TC: Technology Consultant
19. GC: General Contractor
20. SC: Security Contractor
21. OSP: Outside Service Provider
22. NIC: Not In Contract

C. Definitions:

1. ACCEPTED means as accepted by the Technology Consultant or his representative.
2. APPROVED means as approved by the Technology Consultant or his representative.
3. ARCHITECT means Fishbeck or their designated representative.
4. AS DIRECTED means as directed by the Technology Consultant or his representative.

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5. AS REQUIRED means as required by
some other part of the contract documents which may include reference specifications or manufacturer's recommended practice.

6. AS SHOWN means as shown on the drawings, shop drawings, or other graphical elements of the contract documents.

7. BIDDER is used to indicate that entity generating the bid response.

8. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.

9. CONDUIT means the inclusion of all fittings, hangers, supports, sleeves, etc.

10. CONTRACTOR is used to indicate the successful Bidder to whom the Owner has awarded the contract.

11. EQUAL means equivalent as approved by the Technology Consultant or his representative.

12. FURNISH means to indicate the responsibility to ship or deliver the item to the job site, freight prepaid, for receipt, staging, and installation by others.

13. INSTALL means to join, unite, fasten, link, attach, setup or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular work referred to. It is also used to indicate the responsibility of receiving the item at the job site, providing adequate storage, unpacking, or uncrating the item, physically securing the item or otherwise making ready the item for its intended use by following the instructions and approved methods of the manufacturer and those contained herein.

14. OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) shall refer to equipment that shall be furnished by the Owner for installation by the Contractor. The Contractor shall be responsible for installing and integrating this equipment as detailed herein.

15. OWNER or CLIENT means Van Buren Township or their designated representative.

16. PROVIDE means to furnish, install, place, erect, connect, test, and turn over to Owner complete and ready for the regular operation, the particular work referred to.

17. PROVIDED BY OTHERS shall refer to material and work which is related to this contract but has been provided by parties other than the Contractor.

18. The term SHALL is mandatory; the term WILL is informative; and the term SHOULD is advisory.

19. TECHNOLOGY CONSULTANT refers to NV5 Technology and Acoustics, 700 Waterfront Drive, Pittsburgh, PA 15222.

20. WIRING means the inclusion of all raceways, fittings, conductors, connectors, patch panels, labeling, junction and outlet boxes, connections, testing and all other items necessary and/or required in connection with such work.

21. For the purpose of Division 28, in the event of conflict with an abbreviation or definition in Division 01 and in Division 28, the Division 28 abbreviation or definition shall prevail.

1.4 PERMITS, CODES, STANDARDS, AND INSPECTIONS

A. Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Technology Consultant.

B. The installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable with electronic and electrical installations.

C. Unless stated in Division 1, the installation shall be in compliance with the requirements of the latest revisions of:

1. All approved published instructions set forth by equipment manufacturers.
2. All local codes and ordinances in effect and having jurisdiction.
3. Americans with Disabilities Act (ADA)
4. International Building Code (IBC)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. Legislative Act 235 (1965)-Handicapped
7. Legislative Act 287 (1974)-Excavation
8. National Electric Code (NEC)
9. National Board of Fire Underwriter’s (NBFU)
10. National Electrical Manufacturer’s Association (NEMA)
11. National Electric Safety Code (NESC)
12. Occupational Safety and Health Act (OSHA)
13. Telecommunications Industry Association (TIA)

D. Submit certificates issued by approved authorized agencies to indicate conformance of all work with the above requirements, as well as any additional certificates as may be required for the performance of this contract work.

E. Should any change in drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify the Technology Consultant prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instructions of the Architect and the Technology Consultant at no additional cost to the Owner.

1.5 WARRANTIES

A. Provide complete written warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.

B. Any material, equipment, or appurtenance whose operation or performance does not comply with the requirements of the Contract or any equipment which is damaged prior to acceptance shall be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

1.6 PROJECT DRAWINGS AND SPECIFICATIONS

A. The Contractor shall carefully examine the Drawings and Specifications of all trades and report all discrepancies to the Technology Consultant in writing to obtain corrective action. No departures from the Contract Documents shall be made without prior written approval from the Technology Consultant.

B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Technology Consultant. The Engineer's interpretation is final and binding.

C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.

D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Technology Consultant.

E. If there is a conflict between contract documents, the document highest in precedence shall control. The precedence shall be: first; permits from agencies as required by law, second; special provisions, third; specifications, fourth; drawings, fifth; reference specifications and sixth; vendor submittals.

1.7 COOPERATION AND COORDINATION WITH OTHER TRADES

A. This Contractor shall be responsible for all cross connections and coordination with vendors and other trades to provide a complete operational system. Coordination shall include the Division 8, Division 26, & the Division 27 contractors.

B. When installing equipment in finished spaces on furniture, the Contractor shall coordinate the placement and installation method of the equipment prior to commencing installation.

1.8 PRODUCT LISTING

A. When two or more items of the same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk

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materials, conduit, fittings, sheet metal,
solder, fasteners, and similar items, except as otherwise indicated.

B. Provide products that are compatible within systems and other connected items.

C. All powered equipment shall be UL listed and follow approval criteria defined by the local authority having jurisdiction.

1.9 RECORD DOCUMENTS

A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant and Owner a complete set of documents that clearly represent all contract work “as-built.” This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation.

1.10 MAINTENANCE MANUALS

A. Prepare maintenance manuals (Record Document) in accordance with the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer’s data of each piece of equipment.

1.11 GENERAL WARRANTIES

A. Provide complete warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.

1.12 ANY MATERIAL, EQUIPMENT OR APPURTENANCE WHOSE OPERATION OR PERFORMANCE DOES NOT COMPLY WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS OR WHICH ARE DAMAGED PRIOR TO ACCEPTANCE SHALL BE HELD AS DEFECTIVE AND SHALL BE REMOVED AND PROPERLY REPLACED AT NO ADDITIONAL COST TO THE OWNER.

PART 2 PRODUCTS

2.1 GENERAL

A. Major items of equipment shall have manufacturer’s name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturers that are suitable for use in a unified system.

B. All materials and equipment for which Underwriter’s Laboratories have established standards shall bear a UL label of approval.

C. Where proprietary names are used, whether or not followed by the words “or as approved,” they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.

D. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size, and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage, and handling.

3.2 INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of systems, materials, and equipment.

B. Coordinate systems, equipment, and materials installation with other building components.

C. Verify all dimensions by field measurements.

D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for cabling installations.

E. Sequence, coordinate, and integrate installations of cabling materials and equipment for efficient flow of the Work.

F. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components.

G. Coordinate the cutting and patching of building components to accommodate installation of cabling equipment and materials.

H. Coordinate the installation of all materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.

I. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

J. Ensure that the fire rating of all walls and floors is maintained. Plywood backboard sheets shall have the fire-rated stamp left visible for inspection.

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K. Plywood on walls shall be void-free fire-resistant grade AC grade or better with a minimum thickness of 0.75 inches with two coats of fire-resistant paint. Use flush hardware and supports to mount plywood. Ensure that the strength and placement of the hardware are sufficient to handle the total anticipated load and mounting of cabling components.

L. Plywood on walls shall be void-free A/C grade and treated with two coats of fire-resistant paint.

M. Ensure that the fire rating of all walls and floors is maintained.

3.3 CABLE PROTECTION

A. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

3.4 CONDUIT AND RACEWAY

A. Actual locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site.

B. Provide a pull box or pull point immediately before and after any conduit or raceway section containing three 90° bends, or any single interior run exceeding 50' in length. Pull box openings must face in the direction from which personnel shall approach and must have a minimum eight inches in front of and to all sides of the opening. Pull boxes shall not be used in place of a bend. Conduits must always exit the pull box from the opposite side it entered (no change of direction inside the pull box shall be accepted).

C. Carefully investigate the structural, electrical/electronic, and finished conditions of work accordingly.

3.5 FIRESTOPPING

A. General

1. Provide through penetration fire stop systems to prevent the spread of fire through openings made in fire-rated walls or floors to accommodate penetrating items such as conduit, cables, and cable tray. Fire stop shall restore floor and wall to the original fire rated integrity and shall be waterproof. The fire stop systems and products shall have been tested in accordance with the procedures of U.L. and material shall be U.L. classified as materials for use in through-penetration fire stops.

2. The fire stop system shall comply with the NEC and with NFPA 101-Life Safety Code (latest edition) and shall be made available for inspection by the local inspection authorities prior to cable system acceptance. The Contractor shall be responsible for verifying the fire rating of all walls and floors having cabling penetrations. Coordinate sealant installation with work of other trades and with the general contractor on site.

3. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) or shall be approved by a qualified Professional Engineer (PE), licensed in the State of Michigan. A drawing showing the proposed fire stop system shall be provided to the Owner and Technology Consultant prior to installing the fire stop system(s).

3.6 GROUNDING AND BONDING

A. Ground communications systems and equipment in accordance with the TIA-607 Grounding Standard and NEC requirements except where the Drawings or Specifications exceed NEC requirements. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, paging equipment, CATV equipment etc. entering or residing in technology spaces shall be grounded to the respective ground system using a minimum #6 AWG solid copper bonding conductor and compression connectors. All wires used for technology grounding purposes shall be identified with green insulated wires. All cables and bus bars shall be identified and labeled in accordance with the Technology Identification requirements.

3.7 TESTING

A. Contractor, at his own expense, shall make any tests directed by an inspection authority or by the Technology Consultant and shall provide all equipment, instruments, and materials to make such tests.

B. Upon completion of work, all component parts, both singularly and as a whole, shall be set, calibrated, adjusted and left in satisfactory operation condition to suit load conditions, by means of instruments furnished by the Contractor.

3.8 FINAL PUNCH LIST SCHEDULING

A. The Contractor shall request a final punch list appointment by completing a “Pre-Punch Verification Form” and returning it to the Consultant. By signing the form, the Contractor indicates that the work on this contract, as defined in the Security Drawings and Division 28 Specifications, is complete and ready for the Consultant’s final visit.

B. If the Contractor’s work is found to be incomplete, and subsequent visits to the site by the Consultant are required by the Owner, the Owner may elect to have the Consultant’s travel costs, billable time, and all other related travel expenses be borne by the Contractor.

END OF SECTION

SECTION 280100 - OPERATION AND MAINTENANCE OF ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 SUMMARY

A. This project consists of providing a new access control and surveillance system for the New Community Center. The access control and surveillance system shall be as shown on the drawings for this location. This project shall include cabling as required to support both systems as well as all associated electronics.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.

B. This section is inclusive to all Division 28 sections.

C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

1.3 DRAWINGS

A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.

B. All work shall be subject to the Owner's direction and approval.

1.4 QUALITY ASSURANCE

A. In addition to procedures stated in Division 1:

1. Cutting and Patching

a. Perform required cutting, drilling, and chasing to receive new equipment. In general, perform all patching and repairing necessary to restore to original condition, all surfaces that may become damaged during the installation. All work shall be executed by persons normally employed in the type of work to which they are assigned.

b. Paint all structural steel and all steel parts used for hangers and for supporting conduits, junction boxes, and technology equipment with one (1) coat of "red" oxide primer before erection. After steel is in place, paint again with a minimum of one (1) coat of paint, color as directed by the Engineer or Architect.

c. The security contractor is responsible for all cutting and patching associated with the new installation.

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2. Clean Up

   a. Upon completion of the contract, remove all workmen's appurtenances from the premises. Clean the premises of all debris caused by the work and leave the installation clean and in first-class operating condition.

3. Storage of Material and Equipment

   a. Store materials and equipment in a location approved by the Owner.

   b. Be responsible for the condition of all materials and equipment employed in the installation until final acceptance by the Owner.

   c. Be responsible for the replacement of all damaged or defective work, materials, or equipment. Do not install sensitive or delicate equipment until major construction work is completed. Ensure that equipment is protected from all construction site activities.

   d. Conform to all applicable safety regulations required by the Owner & OSHA.

1.5 INTERPRETATION AND CONFLICTS

A. Bring any discrepancies determined or omissions found lacking in the Contract Documents to the Technology Consultant's attention before submitting the bid. After award of Contract, the Owner or Technology Consultant shall make the interpretation of any conflict.

B. The failure to question any controversial item shall constitute acceptance by the Bidder who shall execute it to the satisfaction of the Owner after being awarded the Contract.

C. If mention has been omitted pertaining to details, items or related accessories required for the completion of any system, it is understood such item and accessories are included in the Contract. After the Contract is awarded, claims based on insufficient data or incorrectly assumed conditions, or claims based on misunderstanding the nature of the work, shall not be recognized.

D. The General Conditions, Requirements, and Special Provisions, of any larger body of specifications, of which this Specification may be a part, are hereby made a part of this Specification. In the event that any clauses or provisions of the larger body of specification conflict with the letter or intent of this Specification, the Contractor shall immediately notify the Engineer and the Technology Consultant for clarification and direction.

E. All work shown shall be new work provided under this Contract except that work labeled "present to remain" and that equipment labeled "to be furnished by others but installed by the Contractor."

1.6 LABELING AND IDENTIFICATION

A. Clearly LABEL all new equipment, devices, and miscellaneous apparatus for easy identification and for safety.

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1.7 LOCATION OF EQUIPMENT AND RACEWAY

A. The drawings are diagrammatic and indicate the general arrangement of equipment to be installed.

B. Coordinate the structural, electrical/electronic, and finished conditions of work accordingly.

C. Coordinated locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site. Install all items to accommodate the various conditions in the building and make deviations necessary without additional cost. After the existing ceilings have been removed and prior to commencement of installation, prepare coordination drawings for work under this division, as specified in Division 01, in full cooperation with persons performing work under other Divisions, including but not limited to mechanical, electrical, plumbing, fire protection, information technology cabling, conduit and cable trays, and existing structure. Conflicts encountered due to existing conditions shall be coordinated prior to the installation of all equipment, ductwork, or piping systems. Any modifications to the equipment, duct, or piping layout shall be reviewed by the Designer and shall not constitute any additional cost to the Owner. Full coordination drawings shall be required for the entire facility.

1.8 WIRING METHODS

A. Install all wire and cable located in finished areas in new or existing raceways as indicated on Drawings.

B. Install new raceways in the locations shown on the drawings and as specified.

1.9 ORDINANCES AND CODES

A. Nothing contained in the Specifications or shown on the drawings shall be construed as to conflict with any local, municipal or state laws and regulations, governing the installation or other contract work, and all such ordinances and regulations, including the latest: National Electric Code, TIA standards and the National Electric Safety Code, are hereby incorporated and made a part of these Specifications, and shall be satisfied by the Contractor at no additional expense to the Owner.

B. Secure all permits and inspection certificates for submission to the Owner.

1.10 SYSTEM CONTINUITY

A. Reconnect all existing items that remain in use. Provide all materials and labor required to retain continuity of existing circuits or systems that are disrupted by these alterations even though not indicated on the drawings.

1.11 SUBMITTALS

A. Shop drawings shall be checked, corrected, and approved by the Contractor before being submitted to the Owner/Technology Consultant for review. Before submitting shop drawings, the Contractor shall carefully examine them and shall certify by his stamp/signature that, to

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the best of his knowledge, they comply with
the Contract Documents. The Contractor must receive written approval from the Owner or an authorized representative of the Owner, in writing, prior to fabricating or installing any materials. Approval shall be given based upon shop drawings. The shop drawings shall indicate complete details of work to be performed. Drawings shall include a title block naming the Project, Engineer, Technology Consultant, Contractor, drawing title, drawing number, revision number if applicable and date. Submit all Shop Drawings complete as a single submission. Isolated items shall not be accepted, except with prior approval.

B. Where the shop drawings deviate from the requirements of the Contract documents, the Contractor shall (1) correct the shop drawings as required, or (2) where the deviations do not necessarily require correction, notify the Owner/Technology Consultant of the deviations.

C. Submit to the Technology Consultant four (4) sets of shop drawings or otherwise noted documents/equipment for the following equipment and obtain written approval before ordering materials. See the drawings and scope information for applicability of product to phase and project:

1. Access Control Panels
2. Power Supplies
3. Cabling
4. Protection Devices
5. Patch Cables
6. Cable management Devices
7. Cameras
8. IP Camera Cabling
9. Camera Housings
10. Monitors
11. Servers and Workstations
12. Software
13. Racks and cabinets
14. Grounding equipment
15. Hangers and Supports
16. Strain relief products
17. Intercom Equipment
18. Indoor and outdoor Intercom Stations

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19. All other equipment identified or inferred
    and as may be required by the Engineer, Architect, Technology Consultant or Owner.

D. Submit complete submittal list for Owner/Technology Consultant review prior to purchasing any equipment.

E. Where multiple products are shown on one cut sheet, circle product to be used.

F. In some cases, manufacturer warranty may call for the review of system documentation to assure that the system design meets manufacturer warranty requirements. In such instance, with prior approval of the Owner, the Contractor shall provide a complete set of Project Documents and product data to the system manufacturer for review. The system manufacturer shall review the complete system package and provide documentation attesting to the system compliance with manufacturer warranty requirements. This documentation shall be included with the Contractor Shop Drawings submittal. The Technology Consultant shall not review the Contractor Shop Drawings submittal which does not include the manufacturer warranty compliance review documentation.

G. Each shop drawing shall contain reference to the applicable drawing and specification section and verification of compatibility with the systems involved.

H. All nameplate data shall be submitted with equipment submittals – refer to other sections for complete identification requirements.

I. Shop drawings shall show conformance with specified performance characteristics, or the Contractor shall assume responsibility for all deviations including all additional costs as a result of the deviations.

1.12 STANDARDS OF MATERIAL AND WORKMANSHIP

A. All work shall be executed by persons skilled in the work to which they are assigned. This shall include all copper and fiber connections including testing, and all plastering and painting.

B. All materials and equipment in the work shall be new and of first quality, produced by manufacturers of recognized reputation for each line of material and equipment. The fact that materials or equipment offered have been recently developed or are untried may be sufficient justification for their rejection.

1.13 PROTECTION OF WORK AND EQUIPMENT

A. The Contractor shall use the required safety precautions, methods, and skills to prevent possible unsafe conditions or conditions unduly susceptible to fire.

B. When the Contractor is working in areas in which the building occupants have access, Contractor shall provide suitable barriers around his operation.

C. The Contractor is responsible for containing the undue spread of vapors or odors from his work area.

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1.14 TESTS AND INSTRUCTIONS

A. Upon completion of the work, and upon the request of the Technology Consultant, the Contractor shall be prepared to test all systems in the presence of the Owner or Technology Consultant. Such testing shall occur at a time that is mutually acceptable to all parties. The Contractor's representatives assisting in the performance of these tests shall be thoroughly familiar with the details of the system and shall include the field supervisor responsible for installing the system.

B. Correct all failures or improper conditions.

C. Demonstrate to the Owner the proper care and maintenance of all new items.

1.15 GUARANTEE

A. Unless stated otherwise in Division 1:

1. The Contractor and his surety shall guarantee in writing for a minimum period of one (1) year from the date of final acceptance that all materials, equipment, and labor furnished by Contractor are free from defects.

2. The Contractor shall further guarantee that if any piece of material or equipment is found to be defective within the guarantee period because of faulty manufacture or faulty installation, in the opinion of the Owner, Contractor shall replace, install, and test such material or equipment without any further expense to the Owner.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 280526 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.

B. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

1.2 SUMMARY

A. This Section includes solid grounding of technology systems and equipment. It includes basic requirements for grounding for protection of life, equipment circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

B. Comply with the TIA-607, “Grounding and Bonding Requirements” and the NEC.

1.3 SUBMITTALS

A. Submit the following:

1. Product data for connectors and connections materials, and grounding fittings.

   a. Where multiple products are shown on one cut sheet, circle product to be used.

2. Field-testing organization certificates, signed by the Contractor, certifying that the organization performing field tests complies with the requirements specified in Quality Assurance below.

3. Report of field tests and observations certified by the testing organization.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings of types and rating required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer: Qualified with at least 3 years of successful installation experience on projects with technology ground work similar to that required for this project.

C. Listing and labeling: Provide products specified in this Section that are listed and labeled. The terms “listed” and “labeled” shall be defined as they are in the National Electric Code, Article 100.

D. Listing and Labeling Agency Qualifications:
A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

E. Field-testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated.

F. Component Standard: Components and installation shall comply with NFPA 70, “National Electric Code” (NEC).

G. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical and electronic grounding.

H. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical and electronic grounding.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. B-Line Systems, Inc.
2. Burndy Corp.
3. Crouse-Hinds Co.
4. Electrical Components Div.; Gould Inc.
5. General Electric Supply Co.
6. Ideal Industries, Inc.
7. Thomas and Betts Corp.

2.2 PRODUCTS

A. Supply types indicated and of sizes and rating to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 CONDUCTOR MATERIALS

A. Copper with min 98% conductivity.

2.4 WIRE AND CABLE CONDUCTORS

A. Coordinate with Division 26 and Division 27 Sections.

B. Equipment Grounding Conductor: Green insulated.

C. Grounding Electrode Conductor: Stranded cable.

D. Bare Copper Conductors:

1. Conform to the following:

a. Solid Conductors: ASTM B-3.

b. Assembly of Stranded Conductors: ASTM B-8.

c. Tinned conductors: ASTM B-33.

2.5 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section. All bus bars shall be two-hole lug type.

B. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch-thick and 2 inches wide, except as indicated.

C. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire, 3/4” wide, 9-½” long; 48.250cm. Protect braid with copper bolt-hole ends with holes sized for 3/8” diameter bolts.

2.6 CONNECTOR PRODUCTS

A. Listed and labeled as grounding connectors for materials used and approved by a nationally recognized testing laboratory.

B. Pressure Connectors: High-conductivity-plated units. All lugs shall be two-hole type.

C. Bolted Clamps: Heavy-duty units listed for the application.

2.7 GROUNDING ELECTRONICS

A. For technology systems, provide a #6 AWG minimum insulated stranded copper conductor from the grounding electrode system to each telecommunication room, terminal cabinet, and central location.

B. Bonding Plates, Connectors, Terminals, and Clamps: Provide electrical bonding plates, connectors, terminals, lugs, and clamps as recommended by manufacturers for indicated applications.

C. Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps, as recommended accessories by manufacturers.

PART 3 EXECUTION

3.1 GENERAL

A. Each facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical building ground and shall be designed in accordance with the recommendations contained in the TIA - 607 Telecommunications Bonding and Grounding Standard. All security equipment and systems residing in telecommunications rooms shall be properly connected to the TBB.

B. The main communications entrance facility/equipment room shall be equipped with a telecommunications main grounding bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bar (TGB) connected to the TMGB by a #6 AWG minimum insulated stranded copper conductor. The TMGB shall be connected to the building electrical entrance grounding facility (master ground bus) with a #2 AWG minimum insulated stranded copper conductor. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, and security equipment entering or residing in telecommunication spaces shall be grounded to the respective TGB or TMGB using a minimum #6 AWG insulated stranded copper conductor and compression connectors.

D. All cables and bus bars shall be identified and labeled in accordance with the Identification requirements Section 280553.

E. Except as otherwise indicated, provide grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), bonding jumper braid, surge arresters, and additional accessories needed for complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards for applications indicated.

F. All bonding conductors shall not be placed in a ferrous metallic conduit. If it is necessary to place any bonding conductors in ferrous metallic conduit that exceeds 1 meter in length, the grounding conductors shall be bonded to each end of the conduit with a conductor sized as a # 6 AWG minimum.

G. All connections to building steel shall be exothermically (CAD) welded and connected to the telecommunications grounding bus bar with a minimum #2 AWG cable.

H. All cable tray and equipment racks shall be bonded together with grounding straps of a minimum of a #6 AWG cable. Bonding cables shall be equipped with a compression type ground lug on both ends. The ground lugs shall be attached to a point on the rack that is free of paint and equipped with a star washer. After connecting the ground lugs, seal the connection.

I. All ground cable connections to the telecommunications ground bar shall be with compression type lugs. No setscrew type lugs shall be used.

J. All ground conductors shall be routed in a neat and workmanlike manner and shall be free of splices, sharp bends, and kinks.

K. All new and existing protected entrance terminals in the telecommunications room shall be grounded and connected to the telecommunications grounding bar with a # 6 AWG conductor.

L. Bond the Data/Communications cable tray located in the at the building service entrance points with a minimum of # 2 AWG cable. Note that each tray is grounded at one building service entrance panel only. Connect the bonding conductor to the tray bonding conductor with a compression type fitting. No setscrew type lugs shall be used.

3.2 INSPECTION

A. Installer must examine areas and conditions under which technology grounding connections are to be made and notify the Technology Consultant in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner.

3.3 APPLICATION

A. Provide technology grounding systems where shown, in accordance with applicable portions of NEC and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.

3.4 INSTALLATION

A. Ground communications systems and equipment in accordance with the TIA -607 Grounding Standard and NEC requirements except where the Drawings or Specifications exceed these requirements.

B. Coordinate with other work as necessary to interface installation of grounding system with other work.

1. Where the security equipment is located in the buildings' Telecom rooms, the security contractor shall, in lieu of building out a separate grounding system, tie the security system's grounds to the telecom grounding system.

C. Route grounding conductors along the shortest and straightest paths without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

D. Install bonding connections in accessible locations with approved components.

E. Each TGB shall be directly bonded to the main electrical ground rod.

F. The TGB and TMGB must be visibly labeled and physically secured.

G. Where the ground wire is exposed support at a minimum of every 24” both vertically and horizontally.

3.5 CONNECTIONS

A. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact shall be galvanically compatible.

B. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer to in order of galvanic series.

C. Make connections with clean bare metal at points of contact.

D. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

E. Tighten grounding and bonding connectors and terminals, (including screws and bolts) in accordance with manufacturer’s published torque tightening values for connectors and bolts. Where manufacturer’s torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Upon completion of installation of technology grounding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 10 ohms, take appropriate action to reduce resistance to 2Ω or less.

3.7 LABELING

A. All ground cables shall be labeled in accordance with ANSI/TIA-606.

END OF SECTION

SECTION 280529 - HANGERS AND SUPPORTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Provisions and Supplementary Conditions, Specification Sections, apply to this and the other sections of Division 28.

B. This section is a Division 28 BASIC section and is to be considered as a part of each Division 28 section.

C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

1.2 SUMMARY

A. This Section includes secure support from the building structure for security items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

B. All support shall utilize threaded fasteners for all technology/attachments

1. Exception:

a. Spring steel fasteners may be used in lieu of threaded fasteners only for ¾” raceways above suspended ceilings.

C. Types of supports, anchors, sleeves, and seals specified in this section include the following:

1. Clevis hangers
2. Riser clamps
3. C-clamps
4. I-beam clamps
5. Conduit straps
6. Round steel rods
7. Lead expansion anchors
8. Toggle bolts
9. Wall and floor seals

D. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly or as specified in Division 28.

1.3 SUBMITTALS

A. Submit the following in accordance with Conditions of Contract and Supplementary Conditions Specifications Sections.

1. Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve, and seal.

a. Where multiple products are shown on one cut sheet, circle product to be used.

2. Shop Drawings: Submit dimensioned drawings of fabricated products, indicating details of fabrication and materials.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacturing of supporting devices, of types, sizes, and ratings requirements, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Contractor Qualifications: Firm shall have at least 3 years of successful installation experience with projects utilizing electronic/electrical supporting device work similar to that required for this project.

C. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of supporting devices.

D. UL Compliance: Provide components that are UL listed and labeled.

E. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe, and cable.

F. Components shall be listed and labeled by ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturers that are suitable for use in a unified system.

B. All materials and equipment for which Underwriters Laboratories have established standards shall bear a UL label of approval.

C. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.

D. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size, and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide supporting devices that comply with manufacturers' standard materials. Install in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Contractor's option.

B. Install hangers, anchors, sleeves, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NEC for installations of supporting devices.

C. All camera mounting brackets (wall, pendant, & parapet) shall be of proper wind rating such that they are resistant to wind sway and vibration. Camera devices shall be installed to maximize stability.

D. Support all technology cables a minimum of every 4' with J-hooks unless other supports are available. For CCTV Camera cabling and all other Category 6 (or 6A) cabling, utilize only those systems specifically approved for that type of cabling.

E. Coordinate with the building structural system and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

F. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

G. Obtain approval from the Engineer and Architect before drilling or cutting structural members.

H. Install surface-mounted cabinets and panels with minimum of four anchors.

3.2 MISCELLANEOUS SUPPORTS

A. Support miscellaneous technology components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panels, control enclosures, pull boxes, junction boxes, and other devices.

3.3 FASTENING

A. Unless otherwise indicated, fasten technology items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, cabinets, panels, boxes, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts, or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

B. Holes cut into reinforced concrete beams or in concrete shall not cut reinforcing bars. If the Contractor cuts into any reinforcing bars, stop work and notify the Technology Consultant immediately. Fill all holes that are not used.

C. Ensure that the load applied to any fastener does not exceed 25% of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

3.4 TESTS

A. Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:

1. Expansion anchors.

2. Toggle bolts.

3. Powder-driven threaded studs.

END OF SECTION

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SECTION 280553 - IDENTIFICATION FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.

B. Drawings and general provisions including Division 1, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for identification of components including but not limited to the following:

1. Identification labeling for cables and conductors

2. Operational or instructional signs

3. Equipment labels and signs

B. Refer to project drawings and other Division 28 sections for additional specific identification associated with specific items.

C. The Contractor shall submit, for review by the Technology Consultant and Owner, a labeling system for the cable installation. The Owner shall coordinate the exact verbiage of the labeling scheme with the successful Contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cabinets, ground bars, cables, panels, and outlets. The labeling system shall designate the cables' origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings, and all test documents shall reflect the appropriate labeling scheme.

D. All label printing shall be machine generated using indelible ink ribbons or cartridges. Self-laminating labels shall be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel, and wiring block labels shall be installed on, or in, the space provided on the device.

1.3 SUBMITTALS

A. Submit the following:

1. Manufacturer's data for each type of product specified.

2. Schedule of identification and nomenclature to be used for identification signs and labels.

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3. Samples of each color, lettering style and other graphic representation required for identification materials.

1.4 QUALITY ASSURANCE

A. UL Compliance: Comply with applicable requirements of UL Standard 969, “Marking and Labeling Systems”, with regard to type and size of lettering for raceways and cable labels.

B. NEMA Compliance: Comply with applicable requirements of NEMA Standards WC-1 and WC-2 pertaining to identification of power and control conductors.

C. Major items of equipment shall have manufacturer’s name, address and catalog number on the plate securely attached in a convenient place.

1.5 SUGGESTED NUMBERING AND LABELING SCHEME

A. Surveillance Camera: (AAA-B-CC-DD).

1. AAA is the room/corridor the camera is located.

2. B is the camera number in this room/corridor.

3. CCC is the telecom room which serves this camera.

4. DD is the patch panel port of the cable termination.

5. Labeling techniques: The label shall be black letters on white background. Labels must be produced by label-making equipment. The blank white label tags that are included in the faceplate hardware are to be installed with clear plastic shields in all positions on the faceplate.

B. Electronic safety and security electrical receptacles:

1. Each electrical receptacle providing power to any component of the electronic safety and security system shall be labeled with the following information: room number where electrical panel is located, panel number, and circuit number. Each receptacle is to be labeled on top or front of the faceplate or outlet box. Preprinted adhesive labels or tags shall be used.

PART 2 PRODUCTS

2.1 TECHNOLOGY IDENTIFICATION PRODUCTS

A. Cable/Conductor Identification bands:

1. Provide Manufacturer’s standard wrap-around cable/conductor markers, of size required for proper application, and numbered to show circuit identification.

B. Equipment Labels

1. General: Provide engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening.

2. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Lettering and Graphics

D. General: Coordinate names, abbreviations, and other designations used in technology identification work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the technology systems and equipment.

E. Fasteners for Plastic-Laminated Signs shall be self-tapping stainless-steel screws or number 10/32 stainless steel machine screws with nuts and lock washers.

F. Exception: Where specifically approved contact type permanent adhesive may be used where screws cannot or should not penetrate substrate.

PART 3 EXECUTION

3.1 GENERAL

A. Except as otherwise indicated, provide manufacturers' standard products of categories and types required for each application.

B. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in technology identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as reviewed in submittals and as required by standards.

C. Install identification devices as indicated, in accordance with manufacturers' written instructions.

D. Sequence of work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.2 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used on shop drawings, contract documents, and similar previously established identification for project's technology work.

3.3 OPERATIONAL SIGNS

A. Provide instructional signs with approved legend where instructions or explanations are needed for system or equipment operation.

3.4 OUTLET IDENTIFICATION

A. Label each voice and data outlet with the proper designation and provide appropriate icon.

3.5 INSTALLATION

A. Provide equipment identification labels of engraved plastic-laminate on all equipment racks and on major units of technology equipment in buildings. Except as otherwise indicated, provide single line of text, with ½” high lettering on 1½” high label (2” high where two lines are required), white lettering in black filed. Text shall match terminology and numbering of the Contract Documents and shop drawings.

B. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION

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SECTION 281300 - ACCESS CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes a security management information system (SMS) for the new New Community Center and shall provide all of the functionality described herein and shown on the project drawings.

1. SMS components:

    a. Access Control Server

    b. Intelligent Controller

    c. Input Output Devices

    d. Card readers

    e. Biometric readers

    f. Panic Buttons

    g. All cabling as required for each system

2. Security Management System Functionality:

    a. Regulating access through doors and gates.

    b. Issuing and enrolling multiple types of access credentials

    c. Identifying credential via compatible readers.

    d. Anti-passback where required.

    e. Surge and tamper protection.

    f. RS-232, RS-485, and/or IP-based interface.

    g. Interfaced with building UPS/generator.

    h. Production of physical credentials

    i. Managing credential holder database

    j. Monitoring alarms from field-installed devices

    k. Monitoring of field-installed devices.

    l. Tracking and reporting system events

    m. Input and output linking

n. Video interface and control

B. Related Sections:

1. Section 280000: Common Work Results for Electronic Safety & Security
2. Section 280100: Operation & Maintenance of Electronic Safety & Security
3. Section 280529: Hangers and Supports for Electronic Safety & Security
4. Section 280553: Identification for Electronic Safety & Security
5. Section 282300: Video Surveillance System

C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

1.2 PROJECT CONDITIONS

A. Project is a new Community Center in Van Buren, Michigan, that is to be outfitted with Access Control (ACS) and Video Surveillance (VMS).

1.3 ACS PERFORMANCE REQUIREMENTS

A. Distributed Processing: System must be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for access control. If communications to Master Control are lost, all Controllers must automatically buffer event transactions until communications are restored, at which time buffered events must be uploaded to the Master Control.

B. System Capacity:

1. 1000 reader-controlled doors.
2. 10,000 total access credentials.
3. 10,000 supervised alarm inputs.
4. 10,000 programmable outputs.
5. 10,000 custom action messages.

C. System Network Requirements:

1. Provide for automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
2. Communication must not require operator initiation or response and must return to normal after partial or total network interruption such as power loss or transient upset.

3. System must automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.

D. Environmental Capabilities: System must be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient conditions of 60° to 85° F and a relative humidity of 20 to 80 percent, noncondensing.

2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments must be rated for continuous operation in ambient conditions of 36° to 122° F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosure.

3. Interior, Uncontrolled Environment: System components installed in non-air-conditioned and non-temperature-controlled interior environments must be rated for continuous operation in ambient conditions of 0° to 122 ° F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 12 enclosures.

4. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

E. System must provide operator interface, interaction, display, control, and dynamic and real-time monitoring. System must control system networks to interconnect all system components, including workstations and field-installed Controllers.

F. Field equipment must include Controllers, sensors, and I/O devices. Controllers must serve as an interface between the system headend and sensors and controls. Data exchange between the System and the Controllers must include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the System must include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.

G. System Response to Alarms: Field device network must provide a system end-to-end response time of 1 second(s) or less for every device connected to the system. Alarms must be annunciated at the Monitoring workstation within 1 second of the alarm occurring at a Controller or device controlled by a local Controller. Alarm and status changes must be displayed within 100ms after receipt of data by the System. All graphics must be displayed, including graphics-generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console. This response time must be maintained during system heavy load.

H. False Alarm Reduction: The design of System and Controllers must contain features to reduce false alarms. Equipment and software must comply with ANSI/SIA-CP-01.

I. Data Line Supervision: System must initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

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J. Door Hardware Interface: Coordinate with
Division 8 Sections that specify door hardware required to be monitored or controlled by the security access system. The Controllers in this Section must have electrical characteristics that match the signal and power requirements of door hardware, including door monitors and latch detection where required. Integrate door hardware specified in Division 8 Sections to function with the controls and PC-based software and hardware in this Section.

K. Licensing: the system shall be bid to the Owner as a “Turn-Key” system. It shall contain all and any necessary user licenses (at no additional cost) as required for a fully functioning system as specified.

L. Cyber Security: The system shall include provisions within its software designed to protect the various user databases and control functions from attacks from the outside via cyber-space. System shall be configured, at the time when it is turned over to the Owner, to protect against the most recent known threats.

1.4 SUBMITTALS

A. Floor plans showing the entire area with room numbers, locations for each device, riser diagram, point to point diagram, symbol of all devices being used. Indicate system components, location and provide full schematic of wiring system showing building, operation details.

B. Product Data: For each type of product indicated. Include operating characteristics, furnished specialties, and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data must comply with SIA-BIO-01. Include submittals for, but not limited to the following:

1. ACS server

2. ACS Controller

3. ACS I/O Panels

4. Readers and input devices

C. Shop Drawings:

1. Diagrams for panel layouts in equipment rooms with cable management system.

2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable.

3. Wiring Diagrams. Show typical wiring schematics including:

a. Main control panel

b. Typical I/O Panel

4. Battery Calculations

a. Provide battery calculations for power supplies/chargers indicating a minimum 4-hour of battery backup runtime.

D. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. Include the following:

1. ACS software documentation.

2. The Contractor shall provide all software configuration files for any/all software utilized on the project.

3. System installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software must include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.

4. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

5. System installation and setup guides, with data forms to plan and record options and setup decisions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70, "National Electrical Code."

D. Equipment and accessories furnished under the terms of this specification shall be the standard products of manufacturers regularly engaging in the manufacture of this type of product(s) for a period of at least three years.

E. All products within this bid, deemed by the manufacturer as “End of Life” at the time of installation shall be replaced with the next generation replacement in kind, at no additional cost to the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Workstations, and Controllers:

1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50° and 85° F, and not more than 80 percent relative humidity, noncondensing.

2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.

3. Mark packing list with designations that have been assigned to materials and equipment for recording in the system labeling schedules that are generated by cable and asset management system specified in Part 2.

4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

(1) Card Readers: Minimum of two of each type of identification device

(2) Power Supplies: Minimum of two of each type

(3) Credential card blanks, ready for printing. 250 blanks plus an extra 25 % for future use.

B. Fuses of all kinds, power and electronic, equal to 10% of amount installed for each size used, but no fewer than three units.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. MANUFACTURERS

1. The Basis of Design shall be the Lenel/S2 OnGuard platform. Contractors shall provide hardware from Mercury Security as an approved partner of Lenel/S2.

2.2 SECURITY MANAGEMENT SYSTEM (SMS) HARDWARE

A. Intelligent Controller (IC): The IC shall be a Linux-based access control platform. It shall directly support the above-listed SMS platform(s) The IC shall include the following capabilities:

1. Multi-card & Multi-reader Technology support

a. 8 active card formats per IC

b. OSDP Reader Integration (V.2)

2. AES 128- or 256-bit data encryption

3. MSP1 Encryption

4. HSPD-12/FIPS201 capable

5. UL 294 recognized

6. On-board memory to support:
    a. 2,000,000 user records
    b. 50,000 transactions (event buffer)
7. 255 Access levels
8. High Assurance Credential Authentication
9. BACnet compliant for connection & control of building automation systems
10. Basis of Design: Mercury Security MP 4502

B. I/O Devices

1. Provide I/O devices as required to provide for all door requirements at each equipment room location.
    a. Provide 10% spare capacity at each central equipment location to allow growth without adding more panels.
2. Provide in combination from the following devices to meet the door control and input device requirements for each equipment location.
    a. Mercury Security MR50
    b. Mercury Security MR51e
    c. Mercury Security MR52
    d. Mercury Security MR16IN
    e. Mercury Security MR16OUT

C. Wall-Mount Cabinets

1. Contractor shall utilize the larger size cabinet for their controllers to allow better working space within.
2. Provide cabinets as provided by or recommended by the SMS System manufacturer.
3. All cabinets/boxes shall include tamper switches.

D. Card Reader:

1. Provide wall-mounted and\or mullion-mounted card readers as shown on the drawings. Card readers shall be sized and selected to fit the available space and shall be approved in advance before purchase.
2. Card Readers shall be compatible with existing card base but be capable of the latest in secure reader transmission protocol {MIFARE DESFire (EV1 & EV2)}.

E. Panic Button

1. Provide panic buttons at each location shown on the drawings. Panic buttons shall be connected directly to the Lenel control panels.

   a. Basis of Design: Inovonics EN1235SF

F. Power Supply:

1. Provide Altronix 600 series or approved equal.

2. Provide Altronix PD8CB's for all power supplies.

   a. All locks shall be powered @ 24vdc

   b. All other devices shall be powered @ 12vdc.

3. All power supplies shall be supervised through the OnGuard system.

4. All power supplies shall include battery backup providing a minimum of 4-hour battery runtime.

2.3 APPLICATION SOFTWARE

A. Contractor is responsible to provide, install, configure, and test any or all of the Access Control System's capabilities, based on the project planning process described in Paragraph 3.2.

B. One of the SMS's primary purposes shall be to provide access control. The SMS shall be able to make access granted or denied decisions, define access levels, and set time zones and holidays. An input or output linkage feature shall allow linking of monitor zone points to output control points within Intelligent System Controllers (ISCs). The SMS shall support features such as area control (two-man control, hard, soft, and timed anti-passback), database segmentation, and Time zone or holiday overrides.

C. The Contractor shall provide and install a complete Credential Production and Management Subsystem: The SMS shall include a seamlessly integrated credential management module. The credential management functionality must be configured to permit the enrollment of cardholders into the database, capturing of images from video, biometric data, and signatures, as well as the import or export of employee data. This functionality shall also allow the System Operator to assign and/or modify the access rights of a cardholder.

D. Alarm Monitoring: The main Alarm Monitoring window shall provide information about the time and location of the alarm, along with its priority. The main Alarm Monitoring window must be able to sort pending and/or insert new alarms based on any of the following attributes: priority, date or time, alarm description, Intelligent System Controller, Card Reader, Input Control Module, asset name, or cardholder. Date or time sorts must be System Operator selectable to be either ascending or descending and must have the option of displaying the seconds of the minute in which the alarm arrived into the SMS.

E. Digital Video Management: The SMS shall be seamlessly integrated to a digital video management module. It shall support real-time linkage of digital video clips to their associated alarms as well as those from linked devices in the SMS database, Access Control hardware for example. This linkage shall happen automatically as defined by the configuration.

1. Where applicable, System Administrators shall define parameters for video segment creation by specifying pre-alarm and post-alarm durations. The system shall automatically associate alarms from linked hardware with the linked camera's pre and post-alarm durations.

2. The SMS shall support Digital and Network Video Recorders from multiple manufacturers. The SMS shall also support IP-based digital cameras and digital video encoders or servers from multiple manufacturers for advanced video surveillance. The SMS shall support MJPEG, MPEG4 simple profile encoding standards and frame rates to include both PAL and NTSC respectively at maximum of 25/30 frames per second. In addition, the SMS shall support a network-based digital video recorder.

F. Third-Party Interfaces: The SMS shall provide seamless integration with a variety of 3rd party systems. The SMS shall allow alarms and events from the third-party systems to report into the same main Alarm Monitoring window as access control alarms. Third-party interface hardware shall be configured in the SMS access control module. In some cases, System Operators shall be able to control third-party hardware devices from the Alarm Monitoring Workstation. Third-party hardware alarms and events shall be stored in the SMS database for audit trail and reporting purposes.

G. The SMS shall support a real time, bi-directional data interface to external databases such as Human Resources, Time and Attendance, Food Service Systems. The interface shall allow data to be imported into or exported out of the SMS in real-time or in a batch mode basis. Data used for import shall be retrieved directly from an external database or through an import file. Data provided for export shall be applied directly to an external database or through an export file. Any data shall be imported or exported including image data. The file used for import or created by export shall have the ability to be structured in a wide variety of ways but shall always be in ASCII text format.

H. The SMS shall also support a one-step download and distribution process of cardholder and security information from the external database to the SMS database, all the way down to the Intelligent System Controller (ISC) database. This shall be a guaranteed process, even if the communication path between the SMS database and the ISC is broken. If the communication path is broken, the data shall be stored in a temporary queue and shall be automatically downloaded once the communication path is restored.

I. API Development Toolkit: While customization is to be minimized, the SMS shall allow, through API toolkits, System Administrators to expose specific SMS data and events that are relevant to IT information or other third-party systems. Conversely, the SMS shall allow, through these same API toolkits, System Administrators to accept and process information exposed from the IT information or other third-party systems. This shall permit System Administrators to develop scripts and applications that allow events in either the IT domain to cause appropriate actions in the Security domain, and vice versa.

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J. Scheduling Utility: An integral Scheduling Utility shall be provided. The Scheduling Utility shall allow System Administrators to schedule actions to occur on a one-time or a recurring basis. Recurring schedules shall be configured to begin immediately, last indefinitely, or have optional start and end dates.

1. The Scheduling Utility shall maintain a history log in the database for actions that it executes.

K. The SMS shall import and support .pdf, .dxf, & .rvt file extensions (minimum) for use as graphical display format of building layouts. The system shall support map hierarchies or maps within maps. There shall be no limit to the number of maps that shall be nested hierarchically with each other. Multiple maps may be displayed simultaneously

L. Contractor shall install and configure Integrated Intrusion Detection Interface IF required. Provide seamless integration with intrusion detection panels. This shall allow for the ability to monitor intrusion detection alarms in real time inside the SMS alarm monitoring module and allow for command and control of supported intrusion detection. Once alarms are brought into SMS, they shall have the ability to be linked to digital video and/or global I/O, and they shall be stored in the SMS database.

M. Security Management System (SMS) Hardware is required to receive alarms and administer all access granted or denied decisions. All field hardware must be designed to meet UL 294 requirements. The SMS must be able to retrieve device serial numbers from all field hardware, excluding card readers, biometric readers, and keypads.

N. SMS Third-party Devices: The SMS shall interface at the software level via pre-developed interface package with select devices from any 3rd party manufacturers.

2.4 ACS WORKSTATION/BADGING STATION REQUIREMENTS

A. Workstation/Badging Station shall be:

1. Dell XPS Tower Series
2. Intel Core i7-9700
3. Microsoft Windows 11 (64 bit)
4. 16GB DRAM
5. 1 TB Hard Drive (SSD)
6. DVD-read/writable
7. High output graphics card
8. APC Smart-UPS 1500 LCD UPS for each PC and the associated monitor.
9. Equals by SurgeX, Tripp Lite, CyberPower, Minuteman
10. Shall include manufacturer’s badge printer and all relevant associated materials.

B. Monitors shall be:

1. 24” Monitor shall be Dell Model U2418HX, complete with the following features/options:

a. 1920 x 1200 @60Hz native resolution

b. 16.7 million colors

c. Front Panel Controls

d. Contrast ratio 8,000,000:1 (dynamic mode)

e. 2 x HDMI inputs, VGA

f. 120-volt operation

2.5 SURGE AND TAMPER PROTECTION

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.

1. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components must initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display must identify tamper alarms and indicate locations.

2.6 CABLES

A. Supply manufacturer-recommended cable types for all devices including:

1. Card readers & devices

2. Electronic locks

3. Door Contacts

4. Motion Sensors

5. Latch Detectors

6. Local Alarm Sounders

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with ANSI/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."

B. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project Drawings and Specifications and publish as Project planning documents for review.

1. Record setup data for control station and workstations.
2. For each Location, record setup of Controller features and access requirements.
3. Propose start and stop times for time zones and holidays and match up access levels for doors.
4. Set up groups, facility codes, linking, and list inputs and outputs for each Controller.
5. Assign action message names and compose messages.
6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
7. Prepare and install alarm graphic maps on VGUI at Master Control Stations.
8. Discuss badge layout options, design badges.
9. Complete system diagnostics and operation verification.
10. Prepare a specific plan for system testing, startup, and demonstration.
11. Develop acceptance test concept and, on approval, develop specifics of the test.
12. Develop cable and asset management system details, input data from construction documents. Include system schematics and Visio Technical Drawings.

C. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.3 GROUNDING

A. Comply with Division-28 Section "Grounding and Bonding for Electronic Safety & Security Systems."

B. Bond shields and drain conductors to ground at only one point in each circuit.

3.4 INSTALLATION

A. Install all devices in strict accordance with manufacturer's instructions.

1. The Contractor shall configure System Administration
2. Contractor shall implement Badge Layout Creation
3. Contractor shall perform Screen or Forms Creation
4. Contractor shall perform Graphical Map Creation
5. Application Programming Interfaces
6. Contractor shall perform Data Import
7. Contractor Install and Configure the System Tape Backup
8. Contractor Install and Configure Client workstations
9. Contractor Configure Archiving
10. Contractor Configure Badge Layout Creation Module
11. Contractor Configure Cardholder Database

B. Access Control Software:

1. Contractor shall configure Time zones
2. Contractor shall configure Access Levels
3. Contractor shall configure Access Groups
4. Contractor shall configure Holidays
5. Contractor shall implement First Card Unlock
6. Contractor shall configure Field Hardware Communications
7. Contractor shall configure Area Control
8. Contractor shall perform Field Hardware Configuration
9. Contractor shall configure Cardholder Use Limits
10. Contractor shall configure Extended Individual Strike Times

11. Contractor shall configure Extended Individual Door Held Open Times

12. Contractor shall configure Extended, on Demand, Door Held Open Times

13. Contractor shall configure Guard Tour

14. Contractor shall configure Security Clearance Levels

15. Contractor shall configure Elevator Control:

C. Conductor terminations in control panels and panels to be made on terminal strips with a separate point for each conductor. All such strips to be number identified as shown in wiring diagram attached to inside of door of control panel. Connect wiring neatly to terminals strips. Place wire neatly in Panduit type wire channels. Set up termination of cabling so that section of the system may be isolated for servicing.

D. Wiring

1. Wiring shall run continuous from device to device. Place wiring in termination and control panels in Panduit wiring channels and form in a neat professional looking manor. No splices shall be permitted except at terminal blocks installed in termination cabinets. The use of wire nuts or crimp type connectors shall not be permitted unless specifically approved by the Owner. Wiring shall be in metal conduit. Where shielded wire is used it shall be connected to an earth ground at the main panel. Data and signal wiring shall be run with shielded wiring. Minimum wire size shall be #18 min.

2. Any devices installed in the ABSL-3 facility shall be properly sealed to maintain air pressure standards.

E. Termination Cabinets

1. Where termination cabinets are used, they shall be installed on walls or in walls in finished areas. Each termination cabinet shall have a hinged cover with a lock installed flush with the cover. These locks shall be keyed alike. Install a white 3/4" plywood backboard inside. Each termination cabinet shall be marked with a sign with the words "sec. termination cabinet" attached to the front cover. This sign shall be constructed from red laminated plastic with 1/4" white engraved letters.

3.5 SYSTEM SOFTWARE

A. Develop, install, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

B. The Contractor shall provide all software configuration files for all and any software utilized on the project

C. Access Control Reports: Configure any and all reports available and requested.

D. Contractor configure Alarm Attributes: The System Administrator shall have the ability to configure how the SMS handles the annunciation of alarms on an individual basis.

1. Contractor shall configure Alarm-Event Mappings
2. Contractor shall configure System Downloads:
3. Contractor shall configure Card Reader Options
4. Contractor shall configure Input Control Module (ICM) Options
5. Contractor shall configure Entry or Exit Delay
6. Contractor shall configure Intelligent System Controller Options
7. Contractor shall configure Basic Integrated Intrusion Functionality
8. Contractor shall configure Alarm Monitoring
9. Contractor shall perform Alarm Annunciation Configuration
10. Contractor shall configure Real-Time, Dynamic Graphical Maps:
    a. Support graphical maps that display device or group status, function lists, and video cameras dynamically in real-time. The maps may be configured to appear on command or when specified alarms are selected for acknowledgment. Map device icons shall have the ability to dynamically change shape and/or color to reflect the current state of the device. The SMS shall indicate if the field hardware is not operating with the most current version of firmware.

3.6 FIELD QUALITY CONTROL

A. Contractor: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. LAN Cable Procedures: If the Category cable is provided as a part of this bid, the Contractor shall inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 6 or 6A tester. Test for faulty connectors, splices, and terminations. Test according to TIA -568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA-568-B. Comply with Section 27 1500 Communications Horizontal Cable.

2. Test each circuit and component of each system. Tests must include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup must be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.

3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.7 CABLE PROTECTION

A. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

3.8 DEMONSTRATION

A. Prior to contract completion, the Contractor shall provide comprehensive demonstration of the fully functioning system to Owner/Architect.

1. Notify the Contractor, Architect and Owner in writing 30 days prior to scheduling the demonstration.

3.9 TRAINING

A. The Contractor is required to perform a minimum of 20 hours of training, broken up into two eight-hour training sessions allowing for the different government branches to attend at their convenience. The final four hours shall be reserved as a follow-up session to correct misunderstandings, or for those who were previously unable to attend. Training shall cover all system functions, including (at a minimum) the following:

1. System setup.

2. System operation.

3. Credential creation.

4. Records keeping.

3.10 CLOSEOUT

A. Provide an additional 16 hours of on-site training, reprogramming, adjustment, and setup after final acceptance at the direction of the Owner for adjustments to the system.

END OF SECTION

SECTION 282300 - VIDEO SURVEILLANCE SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of Division 28.

B. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

1.2 DRAWINGS

A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.

B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

1.3 DESCRIPTION

A. The work required under this section of the specifications consists of the installation of a complete video management system (VMS) for the New Community Center. This system shall be complete in every sense. It shall include all wiring, raceways, power supplies, software, configuration, testing, start up, commissioning, training, and spare parts.

B. The successful Contractor shall provide an upgrade to the latest version of the Floor plans showing the entire area with room numbers, locations for each device, riser diagram, point to point diagram, symbol of all devices being used. Indicate system components, size of components, location and provide full schematic of wiring system showing building, operation details.

C. The successful Contractor shall provide training on the VMS platform to the appropriate personnel as required to optimize the use of this product.

1. The video system shall be integrated with the Access Control System (ACS) to allow the operators to easily integrate the sense and identification functions of both systems as one.

D. Major raceway, outlet boxes and 120-volt power (including power to the outdoor cameras) shall be provided by Division 26 contractor.

E. Specifications include, but not limited to, the following:

1. Video cameras, housings, & mounts.

2. Video monitoring station.

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3. Video Server
4. Power Supplies (as needed)
5. All control wiring and power wiring.
6. All miscellaneous raceways necessary to ensure cable protection.

F. Provide all equipment and accessories for a complete camera system(s) as described herein and as shown on the plans.

G. All equipment, wiring, and operation of the system shall comply with local and state ordinances and UL Standards for Safety.

1.4 QUALITY ASSURANCE

A. Installation shall comply with all applicable codes and standards.

B. All equipment shall be new, in current production, the standard products of an acceptable manufacturer.

C. The manufacturer shall guarantee the availability of parts for a minimum of (5) years from date of shipment. All equipment and software shall be the latest version available from the manufacturer.

D. The manufacturer shall be able to demonstrate the features, functions, operating characteristics, and clarity of picture to the Owner.

E. The system shall be installed by a factory authorized, and trained, Security System Installer.

F. Maintenance and repair service shall be available locally and within (4) hours of notification for emergency conditions.

G. Design Verification and Acceptance

1. The Contractor is responsible for verifying the accuracy of the system designs documented in the Specification and Drawings and acceptance of responsibility. Any issues, discrepancies substitutions, or exceptions to the contract documents by the Contractor shall be communicated to the Technology Consultant prior to the purchase of any equipment or materials by way of the Shop Drawings Submittal process. Upon approval of the Contractor’s Shop Drawing Submittal by the Owner's designated representative, or if the Contractor fails to submit Shop Drawings, the Contractor shall assume all responsibility for supplying such materials and taking such actions as to satisfy the full intentions of the contract documents without claim for additional compensation. This shall include providing any incidental equipment, Installation Materials and labor needed in order to result in a complete and operable system, even if such equipment, materials, or labor are not listed in this Specification. Exceptions include Owner-requested changes, unexpected field issues due to work by other trades, or schedule changes initiated by others.

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H. Equipment and accessories furnished under the terms of this specification shall be the standard products of manufacturers regularly engaging in the manufacture of this type of product(s) for a period of at least three years.

I. All products within this bid, deemed by the manufacturer as “End of Life” at the time of installation shall be replaced with the next generation replacement in kind, at no additional cost to the Owner.

1.5 WARRANTY

A. The system shall be warranted for a period of one year from date of Owner acceptance.

B. Refer to Division 01 for additional warranty requirements.

1.6 SUBMITTALS

A. Floor plans showing the entire area with room numbers, locations for each device, riser diagram, point to point diagram, symbol of all devices being used. Indicate system components, location and provide full schematic of wiring system showing building, operation details.

B. Submit mounting and housing information for each camera for approval to the Owner's Representative. Submit manufacturer's installation instructions.

C. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data.

D. Have installer submit upon completion of system verification a point-by-point checklist indicating the date and time of each item inspected and issue a certificate confirming that the inspection has been completed and the system is installed and functioning in accordance with the specifications.

E. Do not start construction until drawings and submittals have been reviewed by Technology Consultant and Owner's Safety and Security Department.

1.7 SYSTEM DESCRIPTION

A. The purpose of the system is to provide security surveillance and recording of areas shown on drawings.

B. Operation

1. Camera Operating System:

a. Cameras shall be located in appropriate housings and installed at the location to be monitored.

b. Monitors shall be located at the designated monitoring point as shown on drawings.

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C. The system shall be connected to
panic/intrusion devices as required for alarm/event recording and to direct camera to a preset location.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The products herein are based on the Hanwah VMS software, which the Owner has standardized on and no exceptions shall be allowed for that product. For cameras and ancillary products, a “Basis of Design” shall be noted with approved alternate manufacturers; in as much as that product meets all requirements.

1. The “Basis of Design shall serve as a “minimum standard” of functionality. Contractor shall be responsible to provide cameras that shall have the appropriate camera type and lens configuration for optimum viewing.

B. Any substitutions must meet all requirements of Prior Approval, as outlined in the contract documents. Substitutions that meet Prior Approval requirements must be listed as an Alternate by addendum.

2.2 EQUIPMENT

A. Video Storage

1. Provide sufficient storage for each camera shown within the current package plus 25% expansion capability.

a. Maintain a minimum of 30 days storage capacity for the cameras on each NVR, based on:

(1) 16CIF minimum

(2) 3.5 fps when no motion

(3) 15 fps under motion

b. Basis of Design: ### NVR.

B. 360˚ Camera

1. 360˚ cameras shall be:

a. 12-megapixel resolution

b. 360° field of view

c. 1.45mm f/2.2 Lens

d. Remote Zoom & Focus

e. ONVIF compliant

f. 2992x2992 Active Pixels

g. Tamper resistant/weather resistant housing

h. Up to 30fps image rate (0.13 lux (F2.2) in color mode & 0 lux (F2.2) monochrome

i. Electronic Shutter Control

j. Manufacturer #####, Model #####

C. Interior Fixed IP Dome Camera

1. Ceiling mounted or wall mounted cameras shall be:

a. 2-megapixel resolution

b. Available in 3-9mm F1.3, 4.3-8mm F1.9, or 9-22mm F1.6

c. Remote Zoom & Focus

d. Wide Dynamic Range (WDR)

e. ONVIF compliant

f. 1280x1440 Active Pixels

g. Tamper resistant housing

h. Up to 30fps image rate

i. Manufacturer #####, Model #####

D. Exterior Fixed IP Dome Camera

1. Exterior mounted cameras shall be:

a. 5-megapixel resolution

b. Available in 3-9mm F1.3, 4.3-8mm F1.9, or 9-22mm F1.6

c. Remote Zoom & Focus

d. Wide Dynamic Range (WDR)

e. Low-light capable

f. ONVIF compliant

g. 2592x1944 Active Pixels

h. Outdoor dome with weather resistance and IR illuminator included

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i. Up to 30fps image rate

j. Manufacturer #####, Model #####

E. Video Intercom System

1. The contractor shall provide a video intercom system which will allow a visitor to “call up to any of the various departments to be remotely admitted at the visitor’s entrance as well as at the doors at each elevator lobby.

a. The system shall be based on the Aiphone GT series Video Intercom System. The system will consist of the following:

(1) GT Color Video Handsets (Aiphone GT-1M-L) with adjustable desk stand.

(2) Call Button Modules for main Entrance Panel

(3) GT Modular Entrance Panel with audio, video, and camera modules.

(4) All required headend equipment and wiring as required.

(5) All required interface to override door locks from the tenant stations.

(6) Reference Aiphone Custom Spec #TS-1208214FE82RUC-GT

PART 3 EXECUTION

3.1 INSTALLATION

A. The systems shall be installed and configured per the drawings and as specified herein.

B. The camera setup shall be setup, aimed, and focused in coordination with the Owner and Technology Consultant.

1. Contractor shall configure the camera, transceiver (where required), and power supply to optimize the installation process. The power supply shall be selected and configured to accommodate all devices as required to meet the design requirements.

2. Where cameras are installed such that, the distance is too great to meet the Cat 6 100-meter limit, the Contractor shall utilize a combination of twisted pair for power and Multimode fiber for connectivity.

C. Installation shall be accomplished in a professional manner by qualified personnel regularly engaging in and experienced in this type of work for a period of at least 5 years.

1. All Category cabling shall be provided in accordance with the Division 27 specifications from the base building bid package.

2. The successful bidder shall coordinate cable, patch panel, patch cords, etc. with the on-site Division 27 contractor for installation within the telecom rooms as required.

D. All control locations shall have complete full function control of each camera.

E. All fixed lens cameras to be adjusted to the satisfaction of the Owner.

F. Junction boxes to be provided as required to properly install cameras.

G. System shall be completely integrated with the existing VMS and configured for full operation. Confirm final requirements with Owner and Technology Consultant.

H. All custom software shall become the property of the Owner upon final payment with no special or hidden keys preventing updating of the software.

I. Licensing: the system shall be bid to the Owner as a “Turn-Key” system. It shall contain all and any necessary user licenses (at no additional cost) as required for a fully functioning system as specified.

J. PC’s, monitors, power supplies, NVR etc. to be securely rack-mounted in monitoring locations.

K. All wiring shall be installed in conduit or raceway in accordance with UL and manufacturer's recommendations. Any cabling not installed within metal conduits shall be plenum rated. All tie-wraps, accessories, components, cables, etc. shall be UL labeled for installation in an environmental air plenum. All installations shall comply with State of Michigan requirements. This plenum rating requirement shall supersede any catalog numbers listed herein.

L. Labeling

1. Attach to the interior of each control panel a clear plastic holder in this holder place a typed list of the zone numbers and/or area for each camera, the type of camera and all accessories (make and model numbers) with any other information required for ordering replacements. This list shall be typed on 8-1/2" x 11" paper provide a copy of these list(s) on CD/DVD in Microsoft Word compatible format to the Owner.

2. Where junction boxes are installed in concealed areas in the ceiling the box shall have the words "sec. system" attached to the cover. At the access point to the junction box there shall be a sign with 1/4" letters attached to the T-bar grid, this sign shall state "sec. terminal" and shall be constructed from red laminated plastic with white engraved letters. Where the ceiling is solid, the sign shall be attached at the access door nearest to the junction box.

M. Conduits

1. Minimum conduit size for multiple conductor runs shall be 1".

3.2 SYSTEM VERIFICATION

A. The security equipment supplier shall make a thorough inspection of the completed, & installed system including all components to insure the following:

1. Complete and functional system.

2. Underwriters Laboratories requirements.

3. Installed in accordance with manufacturer's recommendations.

    (1) Regulations covering supervision of components are adhered to.

3.3 TESTING AND GUARANTEE

A. Guarantee all wiring and equipment free from inherent mechanical and electrical defects for a period of one (1) year from the date of the installation and acceptance of the Owner. Upon notification of request for warranty service, respond within four hours. If the problem cannot be corrected at that time, present a written plan of correction to the Owner's Plant Operations and Maintenance personnel detailing the problem, the course of action, and a time schedule for correction.

B. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Submit prior to request for final payment.

C. Test each camera type for its specific capabilities and verify integration with the Lenel OnGuard system.

D. Provide 16 hours of on-site instruction to the Owner with regard to proper use and operation of the system. Provide class syllabus as a submittal. Also provide video system operations and maintenance instructions.

E. Provide an additional 16 hours of on-site training, reprogramming, adjustment, and setup after final acceptance at the direction of the Owner for adjustments to the system.

F. Operations and Maintenance Manual: Shall include manufacturers data sheets; maintenance and operation information sheets; as-built drawings showing the final Owner's room numbers; a separate sheet listing all the zones, and other devices, their locations and the exact and specific function of the device as to what it actually is monitoring or operating and any other information available that pertains to the system construction, operation, or maintenance. A copy of this listing of all the zones, or other devices and their functions shall be provided on a CD or DVD in Microsoft Word format. As-built drawings shall be provided on a CD or DVD.

END OF SECTION

SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a complete and functional building fire detection and alarm system.

B. Division of Work:
1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
   a. Electrical Subcontractor:
      1) Coordinate equipment.
      2) Install and wire all system components.
      3) Wire and install all duct smoke detectors. Coordinate location and control requirements with Temperature Control Subcontractor.
      4) Wire tamper and flow switches provided by fire protection (sprinkler) system Subcontractor.
   b. Fire Alarm System Supplier: Test completed system.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of the Section shall comply with the following:
1. NFPA Codes/Standards:
   a. NFPA 70 – National Electrical Code.
   b. NFPA 72 – National Fire Alarm and Signaling Code.
   c. NFPA 101 – Life Safety Code.
   d. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
   e. NFPA 92 – Standard for Smoke Control Systems.
   f. NFPA 13 – Standard for the Installation of Sprinkler Systems.
   g. NFPA 17 – Standard for Dry Chemical Extinguishing Systems.
   h. NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection.
   i. NFPA 720 – Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment.
2. UL Standards
   a. UL 864 – Standard for Control Units for and Accessories for Fire Alarm Systems.
   b. UL 268 – Smoke Detectors for Fire Alarm Systems.
   c. UL 268A – Standard for Smoke Detectors for Duct Application.
   d. UL 521 – Standard for Heat Detectors for Fire Protective Signaling Systems.
   e. UL 228 – Standard for Door Closers-Holders, With or Without Integral Smoke Detectors.
   f. UL 464 – Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.
   g. UL 346 – Standard for Waterflow Indicators for Fire Protective Signaling Systems.
   h. UL 1971 – Standard for Signaling Devices for the Hearing Impaired.
   i. UL 1481 – Standard for Power Supplies for Fire Protective Signaling Systems.
   j. UL 1635 – Standard for Digital Alarm Communicator System Units.

k. UL 2075 – Standard for Gas and Vapor Detectors and Sensors.
3. State: Bureau of Fire Services – State of Michigan
4. Local: City Of Grand Rapids
5. Federal Codes and Regulations.
6. Americans with Disabilities Act (ADA).
7. International Standards Organization (ISO):
   a. ISO-9000.
   b. ISO-9001.

1.4 SYSTEM DESCRIPTION

A. Provide and install a new fire detection and alarm system with a remote LCD annunciator and fire alarm system devices as indicated on Drawings and this specification.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. System shall be programmed to provide early detection of fire, to notify building occupants, summon local fire department, override HVAC operation, and activate auxiliary systems to inhibit the spread of smoke and fire and to facilitate the safe evacuation of building occupants.

1.6 PART 1 - GENERAL

A. Upon the activation of any area smoke detector, duct type smoke detector, heat detector, manual pull station, sprinkler waterflow, the following functions shall automatically occur:
   1. The internal audible device shall sound at the control panel or command center.
   2. The LCD display shall indicate all applicable information associated with the alarm condition including zone, device type, device location, and time/date.
   3. All remote or local annunciator LCD/LEDs associated with the alarm zone shall be illuminated.
   4. Activate visual strobes and audible appliances on general alarm evacuation.
   5. The visual strobe shall continue to flash until the system has been reset. The visual strobe shall not stop operating when the “Alarm Silence” is pressed.
   6. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
   7. Transmit signal to the central station with point identification.

1.7 SUBMITTALS

A. Shop Drawings: For all system components.
   1. Data sheet indicating model number, performance specifications and dimensional data, color and finish.
   2. Details of construction and installation.
   3. Name of manufacturer.
   4. Full system schematic.
   5. Wiring details.
   6. Point-to-point wiring diagram showing all equipment.
   7. Battery calculations.
   8. Floor plan indicating fire alarm system devices only.
   9. Dimension plan indicating all items located inside fire alarm control panel. Plan should indicate future space.
   10. Indicate all features indicated in this specification which are not included in the manufacturer’s equipment. Label these items as “Exceptions to the Specifications”.

B. Layout drawings (plans) identifying all fire detection and alarm system devices. Plans shall be to scale and indicate mounting height for each device.

1.8 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed submittals.
   3. NICET Level 2 certified.

B. Manufacturer:
   1. At least 10 years experience with approved systems.
   2. Having authorized service facility within 150 miles of Site.

C. Components: All components shall be UL listed for intended use.

D. Manufacturer's Services:
   1. Manufacturer's Certificate:
      a. Submit for installed system.
      b. Required Assurances:
         1) Confirmation of final inspection.
         2) Installation conforms to Specifications and Manufacturer's requirements.
   2. Provide Owner training program.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.

D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected material with new materials at no additional cost to Owner.

1.10 WARRANTY

A. The Contractor shall warranty all materials, installation and workmanship for 1 year from date of acceptance, unless otherwise specified.

B. A copy of the Manufacturer's warranty shall be provided with close-out documentation and included with the operation and installation manuals.

C. The System Supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation.

D. Any defects that render the system inoperative shall be repaired within 24 hours of the owner notifying the contractor.

1.11 CLOSE OUT

A. Close out submittals shall include:
   1. Project specific operating manuals covering the installed fire detection and alarm system.
   2. Manufacturer's data sheets and installation manuals/instructions for all equipment supplied.

3. Owner's instruction and operation manual.
4. Record drawings consisting of: a scaled plan of each building showing the placement of each individual item of the fire detection and alarm system as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
5. All drawings must reflect point to point wiring.
6. All drawings shall be provided in standard .DXF format. A vellum plot of each sheet shall also be provided.
7. The application program listing for the system as installed at the time of acceptance by the building owner and/or local AHJ (disk, hard copy printout, and all required passwords).
8. Provide the name, address, and telephone of the authorized factory representative.
9. A filled out Record of Completion similar to NFPA 72, 1999 edition figure 1-6.2.1.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Provide products manufactured by one of the following Manufacturers:
   1. Carrier Global Corporation – Edwards.
   2. Siemens Industry, Inc. – Siemens Fire Safety Division.
   3. Johnson Controls - Simplex.
   4. Honeywell International - Notifier.
   5. Potter Electric Signal Company - Potter IPA Series.
   6. No alternates will be acceptable.

2.2 CONTROL PANEL

A. The control panel(s) shall be a multi-processor based networked system designed specifically for fire, one-way and two-way emergency audio communications, smoke control.

B. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system.

C. The control panel shall include the following circuits:
   1. Class B initiating device circuits.
   2. Class B signaling line circuits.
   3. Class B notification appliance circuits.

D. The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

E. The control panel(s) shall be semi-recessed surface mounted

F. The control panel(s) shall be gray

G. The control panel shall include the following capacities:
   1. Support analog/addressable points required as part of this project and control panel shall be equipped to accommodate an additional spare capacity of 50% for future analog/addressable points prior to the need of adding an additional control panel.
   2. Support network connections up to 63 other control panels and annunciators.
   3. Support multiple digital dialers and modems
   4. Support multiple communication ports and protocols
   5. Support up to 1,740 chronological events.
   6. The control panel or network panels shall include the following features:
      a. Ability to download all network applications and firmware from the configuration computer from the configuration computer from a single location on the system.

b. Provide electronic addressing of analog/addressable devices.
c. Provide an operator interface control/display that shall annunciate, command and control system functions.
d. Provide an internal audible signal with different programmable patters to distinguish between alarm, supervisory, trouble and monitor conditions.
e. Provide a discreet system control switch provided for reset, alarm silence, panel silence, drill switch, previous message switch, next message switch, and details switch.
f. Provide system reports that provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer.
g. Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.

7. The control panel shall contain a standby power supply that automatically supplies electrical energy to the system upon primary power supply failure. The system shall include a charging circuit to automatically maintain the electrical charge of the battery.
8. Operator's Interface/Display:
   a. The system shall allow network functions to be configured to apply to any combination of (panels) in the network
   b. Each control panel(s) (network node) shall be capable of supporting a printer. All system control panel printer ports shall be configurable to output any combination of alarm, supervisory, trouble, monitor, or service group event messages.
   c. Each control panel(s) shall be capable of supporting a LCD display. The display on each panel shall be configurable to display the status of any and all combinations of all alarm, supervisory, trouble, monitor, or service group event messages.
   d. From each LCD display on the system shall be capable of being programmed for control functions of any node or the entire network. The LCD display shall reside on the network as a node and continue to operate with any fault on the network. An LCD shall be capable of being programmed to only be operational when a node is in stand alone mode, with a network fault.
   e. The system program shall have a minimum of 100 system definable service groups definable within the program to allow facilitate the testing of installed system based on the physical layout of the system. Service groups that disable the wiring of circuits serving multiple floors or fire zones shall not be considered as equal.
   f. The operator display shall clearly identify unacknowledged and acknowledged alarm, supervisory, trouble, and monitor status messages.
   g. The system shall provide the ability to download data from the analog/addressable detectors to a PC while the system is on-line and operational in the protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.
   h. A standby power supply shall automatically supply electrical energy to the system upon primary power supply failure.
9. Annunciation:
   a. The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the building.
   b. System shall be equipped to accommodate notification appliances as required for this project plus an additional spare capacity of 25% for future notification appliances prior to the need of adding additional NAC panels.
   c. Standard LED annunciators may be combined in common enclosures provided that the groups of LEDs comprising each of the required annunciators are separated from one another (Detection, Supervisory, Status, and Status) and clearly labeled.
   d. Manufacturers' standard control switches shall be acceptable if they provide the required operation, including performance, supervision, and position indication. If the manufacturers' standard switches do not comply with these requirements, fabrication of custom manual controls acceptable to the Owner is required.
   e. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.
   f. The annunciator shall contain the following system status indicators:
      1) 168 character backlit Liquid Crystal Display
      2) System Normal Indicator

3) System Common Alarm Indicator
4) System Common Trouble Indicator
5) System Common Supervisory Indicator
6) System Ground Fault Indicator
7) System Common Security Indicator
8) System Disabled Point(s) Indicator
9) System Reset Switch with Indicator
10) System Alarm Silence Switch with Indicator
11) System Trouble Silence Switch with Indicator
12) System Message Queue Scroll Switches.
13) 10-Digit Keypad to Enable/Disable System and Functions.

g. The LED annunciator rows shall contain the following format:
1) Provide one row of red (alarm) and yellow (trouble) LEDs. LEDs in each row shall be arranged in columns, one column per type of alarm initiating device, and shall illuminate upon receipt of an alarm signal from the associated device(s) (i.e., electrical room smoke detector).
2) Provide one row of red (alarm) LEDs. LEDs in each row shall be arranged in columns, one column per type of alarm initiating device, and shall illuminate upon receipt of an alarm signal from the associated device(s) (i.e., electrical room smoke detector).
3) Provide one row of yellow (supervisory) LEDs. LEDs in each row shall be arranged in columns, one column per type of supervisory type device, and shall illuminate upon receipt of a supervisory signal from the associated device(s) (i.e., 2nd floor sprinkler valve supervisory switch)
4) The LED annunciator shall be provided with 25% spare LEDs minimum. Each pair of LEDs shall be labeled "Spare".

10. DACT Dialer:
a. The system shall provide off premise communications capability using a digital alarm communications transmitter (DACT) for sending system events to multiple central monitoring station (CMS) receivers.
b. The system shall provide the CMS(s) with point identification of system events using Contact ID or SIA DCS protocols.
c. The system shall also transmit an alphanumeric system activity message, by event, to a commercial paging system of the owner’s choice, using TAP Pager protocol.
d. The system shall provide an individual CMS account for each tenant, and send the required signals to the one or more CMS(s) and account(s) specified by each tenant. In the event of a panel CPU failure during a fire alarm condition, the DACT degrade mode shall transmit a general fire alarm signal to the CMS.

11. Power Supply:
a. System power supply(s) shall provide multiple power limited 24 VDC output circuits as required by the panel.
b. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions.
c. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.
d. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciated as battery trouble and identify the specific power supply affected.
e. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.
f. All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 72. The AC power circuit shall be installed in conduit raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

12. Reports:
a. The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs.

b. The system shall provide these reports via the main LCD, and shall be capable of being printed on any system printer.
c. The system shall provide a report that gives a sensitivity listing of all detectors that have less than 75% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.
d. The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given analog/addressable device loop within any given panel.
e. The system shall provide a report that gives a chronological listing of up to the last 1,740 system events.
f. The system shall provide a listing of all of the firmware revision listings for all of the installed network components in the system.

2.3 INITIATING DEVICES

A. Analog Addressable Smoke Detectors – General:
1. Each Analog addressable smoke detector's sensitivity shall be capable of being programmed individually as most sensitive, more sensitive, normal, less sensitive, or least sensitive.
2. In addition to the five sensitivity levels the detector shall provide a prealarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value.
3. The detector shall provide a maintenance alert signal that 75% to 99% compensation has been used.
4. The detector shall provide a dirty fault signal that 100% greater compensation has been used.
5. The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system.

B. Smoke Detectors:
1. Smoke detectors shall be ionization type, with visible LED alarm light.
2. Separate mounting base and detachable sensor head.

C. Duct Detector Housing:
1. Provide smoke detector duct housing assemblies with air sampling tube sized for duct location to mount an analog addressable detector.
2. Mounting base with auxiliary relay.
3. Provide remote alarm LED indicators and remote test station for each duct type smoke detector.
4. Wired and installed by Electrical Subcontractor. Coordinate exact location with Mechanical Subcontractor.

D. Detector Bases: Provide standard detector mounting bases suitable for mounted on 1-gang, 3-1/2-inch or 4-inch octagon box, and 4-inch square box.

E. Manual Pull Stations:
1. Shall be analog/addressable, single action, single stage, recessed pull-lever, break glass, open circuit type. Finish of the station to be red with lettered instructions "PULL IN CASE OF FIRE."

F. Fire Protection Water Flow Switches And Valve Tamper Switches:
1. To be provided by Fire Protection (Sprinkler) System Subcontractor in accordance with Division 21.
2. For each switch, provide addressable module to monitor status of switch.

G. Addressable Relays/Monitor And Control Modules: Form C normally open/normally closed dry relay contacts rated at 24VDC at 2 amps.

2.4 NOTIFICATION APPLIANCES

A. Low Profile Horn Strobes/Low Profile Strobes:
1. Provide wall mounted horn/strobe with audible output of 84dBA at 10 feet.

2. Horn shall have a selectable steady or synchronized temporal output and shall be wired separately from strobes.
3. Strobes shall provide synchronized flash outputs.
4. Wall mounted strobe Candela ratings of 15cd, 30cd, 60cd, 75cd, 110cd. Candela ratings shall be determined by equipment supplier.
5. Ceiling mounted strobe Candela ratings of 15cd, 30cd, 75cd, 90cd, 115cd, 150cd, and 177cd Candela ratings shall be determined by equipment supplier.

PART 3 - EXECUTION

3.1 WIRING

A. All wiring shall be in accordance with Manufacturer's written recommendations and shall meet all applicable code requirements.

B. All wiring shall be copper.

C. No. 16 AWG minimum for signaling line circuits (SLCs)

D. No. 14 AWG THHN minimum for audible and visual notification appliance circuits (NACs).

E. No. 12 AWG THHN minimum for line voltage.

F. Install wiring completely in metal raceways in accordance with Division 26 "Raceways for Electrical Systems."

G. Install wiring partially in metal raceways in accordance with Division 26 "Raceways for Electrical Systems." Provide junction boxes and conduit sleeves to main corridor areas. Install wiring in conduit sleeves to above ceiling in corridor areas. Wiring in corridor areas does not need to be installed in conduit. Provide cable tray, cable supports, nylon straps as required to properly support cabling in accordance with code

H. Cable type shall be FPLR.

3.2 EQUIPMENT INSTALLATION

A. Manual Pull Stations: Unless otherwise indicated, mount semi-flush in recessed back boxes.

B. Fire Protection Water Flow Switches and Valve Tamper Switches: To be installed in accordance with Division 21 Section "Water Based Fire Protection Systems." Provide wiring and connections for each flow and tamper switch required to be supervised.

C. Duct Smoke Detectors: Connect each duct detector to fire alarm system so upon sensing smoke, fire alarm system goes into alarm. Coordinate location with Mechanical Subcontractor.

D. Heat Detectors: Install at Manufacturer's listed spacing as determined by ceiling height in protected rooms.

E. Smoke Detectors: Install detectors indicated to be ceiling mounted not less than 4 inches from a side wall to the near edge. Install detectors located on the wall at least 4 inches but not more than 12 inches below the ceiling. For exposed solid joist construction, mount detectors on the bottom of the joists. On smooth ceilings, install detectors not over 30 feet apart in any direction. Install detectors no closer than 5 feet from air registers.

F. Smoke Dampers: All smoke dampers in Health Care Facilities shall close upon sensing smoke from a smoke or duct detector. A smoke or duct detector shall be provided for each smoke damper.

G. Audio/Visual Alarm Indicating Devices: Mount at 80 inches above the highest floor level within space or 6inches below the ceiling, whichever is lower. Unless otherwise indicated, install bells and horns on flush-mounted back boxes with the device operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.

H. Fire Alarm Panel (FAP): Top of cabinet not more than 6 feet above the finished floor.

I. Locate remote annunciator as indicated on the Drawings and in accordance with the Authority Having Jurisdiction.

3.3 GROUNDING

A. Ground equipment and conductor and cable shields. For audio circuits, minimize to the greatest extent possible ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5 ohm ground at main equipment location. Measure, record, and report ground resistance.

3.4 FIELD QUALITY CONTROL

A. All intelligent analog addressable devices shall be tested for current address, sensitivity, and user defined message.

B. All wiring shall be tested for continuity, shorts, and grounds before the system is activated.

C. All test equipment, instruments, tools, and labor required to conduct the tests shall be made available by the installing contractor.

D. The system including all its sequence of operations shall be demonstrated to the Owner, his representative, and the local fire inspector. In the event the system does not operate properly, the test shall be terminated. Corrections shall be made and the testing procedure shall be repeated until it is acceptable to the Owner, his representatives and the fire inspector.

E. At the final test and inspection, a factory trained representative of the system manufacturer shall demonstrate that the system functions properly in accordance with these specifications. The representative shall provide technical supervision, and participate during all of the testing for the system.

F. All fire alarm testing shall be in accordance with National Fire Alarm and Signaling Code, NFPA 72.

G. A letter from the Contractor certifying that the system is installed entirely in accordance with the system manufacturer's recommendations and within the limitations of the required listings and approvals, that all system hardware and software has been visually inspected and functionally tested by a manufacturer's certified representative, and that the system is in proper working order.

END OF SECTION

SECTION 31 10 13 – SITE PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the major items listed below:
   1. Clearing Site of above-grade trees, shrubs, grass and plant life.
   2. Removal of the following man-made items:
      a. Walls.
      b. Fences.
      c. Pavement and Curb.
      d. Similar improvements as indicated on the Drawings.
   3. Removal of roots and stumps.
   4. Removal of exposed rocks, boulders and debris.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with the following:
   1. State DOT Current Standards:
      a. Specifications for Construction.
      b. Standard Plans.

1.4 DEFINITIONS

A. Terms: Surface Improvements: Pavement, walks, drives, curbs, curb and gutter, improved lawns, monuments, property irons, reference points and similar improvements.

1.5 SUBMITTALS

A. Permit to Store or Dump Removed Materials:
   1. On property owned, leased or occupied by someone other than Owner.
   2. Submit prior to storing or dumping.
   3. Permit shall absolve Owner from responsibility for storing or dumping.

1.6 QUALITY ASSURANCE

A. Trimming: Trimming of limbs and branches and the painting of tree wounds shall be actively supervised by a member of one of the following:
   1. ASCA – American Society of Consulting Arborists.
   2. ISA – International Society of Arboriculture.
   3. NAA – National Arborist Associations.

B. Interference:
   1. Ensure that Site preparation work does not unduly interfere with pedestrian and vehicular traffic.
   2. Obtain Engineer's and governing authority's approvals prior to closing a public street.

1.7 PROJECT CONDITIONS

A. Burning: Not permitted.

B. Burial: Not permitted.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Soil Erosion Control: Provide soil erosion control in accordance with Division 31 Section "Erosion and Sedimentation Controls" prior to starting Site preparation work.

B. Protection of Trees and Shrubs:
   1. Protect trees and shrubs which are to remain from permanent damage by construction operations.
   2. Prevent vehicles from driving within area under dripline of trees which are to remain.

C. Maintain designated temporary roadways, walkways, and detours for vehicular and pedestrian traffic.

3.2 APPLICATION

A. Clearing:
   1. Remove items requiring removal under this Section from area indicated on Drawings.
   2. Remove roots boulders to a depth of 2 feet below finish grade in the following areas:
      a. Proposed buildings or structures.
      b. Proposed pavements and walks.
      c. Other areas where compaction of the subgrade is required.

B. Prevent Construction Operations from Damaging or Disturbing:
   1. Trees or roots of trees which are to remain.
   2. Surface improvements which are to remain.

3.3 DISPOSAL OF EXCESS MATERIAL

A. General:
   1. Remove and properly dispose of all material not needed to complete Project.
   2. Dispose of excess material at a location off the Site.
   3. Dispose of excess topsoil at a location off the Site.
   4. Disposal of materials shall not violate laws, rules, regulations and the like regarding the filling of flood plains, wetlands and other environmentally sensitive areas.
   5. Provide adequate controls to maintain disposal sites in a neat and safe conditions by periodic leveling of material, the control of erosion and such other practices as are necessary.

END OF SECTION 31 10 13

SECTION 31 22 00 – GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Excavation.
   2. Cutting and filling.
   3. Rough and finish grading.
   4. Disposal of excavated materials.
   5. Topsoil.
   6. Excess water control.
   7. Pavement subgrade.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. AOAC – Association of Official Agricultural Chemists: Methods of Testing.
   2. ASTM Standards:
      a. D422 – Method for Particle-Size Analysis of Soils.
      b. D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort.
      c. D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.
      d. D2487 – Classification of Soils for Engineering Purposes.
   3. State DOT Current Standards:
      a. Specifications for Construction.
      b. Standard Plans.

1.4 DEFINITIONS

A. Terms:
   1. Driving Surface: A pavement, curb, or sidewalk.
   2. Excavation:
      a. Removing the following materials from their present location:
         1) Native below-grade material such as soil, rocks, boulders less than 1/2 cubic yard in volume, and buried trees.
         2) Man-made items such as, but not necessarily limited to:
            a) Bituminous and concrete paving.
            b) Curbs.
            c) Riprap.
            d) Head walls.
            e) Underground utilities.
            f) Manholes and catch basins.
            g) Foundations.
            h) Sidewalks.
   3. Fill: Soil, native material, imported material or other material which is placed over the subgrade, or excavated areas; under roadways, parking areas, walks, buildings, or structures; and anywhere else on the Site.
   4. Grading: The act of moving soil from one location on the Site to another to achieve the contours and elevations as indicated on the Drawings and as herein specified.

5. Hardpan:
   a. Cemented soil layers.
   b. Is not hard clay layers that are not cemented.
6. Imported Material: Soil material which is purchased by Contractor and hauled onto the Site.
7. Native Material: Soil and other natural earth materials, except rock, which are existing on the Site prior to the start of Work.
8. Pavement: Any combination of subbase, base course and concrete, bituminous or aggregate surface course, including shoulders, placed on a subgrade. Includes roadways, parking areas, driveways, and bituminous seal coat.
9. Rock Excavation:
   a. Excavation of igneous, metamorphic or sedimentary rock or hardpan which cannot be excavated without continuous drilling or blasting or continuous use of a ripper or other special equipment.
   b. Excavation of boulders of 1/2 cubic yard or more in volume.
10. Structure: A building, retaining wall, tank, footing, slab, or other similar construction.
11. Subbase: The layer of material placed on the subgrade as part of the pavement structure.
12. Subgrade:
    a. Below structures and below fill on the Site: The top elevation of the undisturbed native material after all topsoil is stripped off and excavation is completed.
    b. Below driving surfaces: The bottom elevation of the subbase.
13. Surface Improvement: All improvements beyond what might be encountered in an open unimproved field.
14. Undercut: Excavation of native material from below the bottom of footings, floors, structures, and subbases.
15. Utility Structure: Manhole, catch basin, valve chamber, junction chamber, water main valve, or other similar utility appurtenance.
16. Other Definitions: Other earthwork terms not defined in the Contract Documents shall be as defined in state DOT Standard Specifications for Construction.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Quantities: Determine the required quantities of all earthwork materials and operations and use as the basis for the lump sum Bid.

1.6 QUALITY ASSURANCE

A. Testing will be performed in accordance with Division 01 Section “Testing Services for Buried Utilities, Roadways, and Site Projects” and the Contractors Quality Control Plan.

B. Compaction:
   1. Predominately Granular Soils:
      a. Density shall be determined by using the modified Proctor method, ASTM D1557.
      b. Compact fill to at least 95% maximum density.
      c. The first 12 inches of subgrade below all driving surfaces, structures, utility structures, and fill on the Site:
         1) Shall be tested for density.
         2) Compact to at least 95% maximum density if the existing density is below 95%.
   2. Predominately Cohesive Soils:
      a. Density shall be determined by using the standard Proctor method, ASTM D698.
      b. Compact fill to at least 98% maximum density.
      c. The first 12 inches of subgrade below all driving surfaces, structures, utility structures, and fill on the Site:
         1) Shall be tested for density.
         2) Compact to at least 98% maximum density if the existing density is below 95%.

1.7 PROJECT CONDITIONS

A. Dust Control:
   1. Use all legal means necessary to control dust on and near the Work and on and near all off-site borrow areas if such dust is caused by Contractor's operations during performance of the Work or if resulting from the condition of the Site when earthwork operations are suspended.
   2. Treat haul roads, delivery roads, temporary site access roads and other surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the Site.
   3. Scrape, broom, or vacuum adjacent streets to remove tracked dirt every Friday afternoon, or more often as necessary if directed by Engineer. Utilize vacuum if dust from brooming is excessive in opinion of Engineer.

B. Existing Structures, Utility Structures, and Utilities:
   1. Call MISS DIG to locate all existing underground utilities prior to starting excavation.
   2. Where utilities, utility structures, or structures are encountered which are in active use:
      a. Provide adequate protection for them.
      b. Be responsible for damages to them.
   3. Provide stand-by utility service if temporary removal is necessary for a period exceeding 2 hours.
   4. Where utility service connections to occupied buildings must be temporarily disconnected, give 48 hours notice to the affected occupants of the time and duration of the anticipated shut off.
   5. Notify Fire Department 48 hours in advance if water main or fire supply line shutoff is required.
   6. Raise, lower, or move underground utilities, utility structures, or structures which interfere with the utility, utility structure, or structure being constructed as part of this Work.

C. Special Filling Requirements:
   1. Comply with the regulations of the state DOT, county road, and railroad company engineering departments with regard to placing fill and compaction in their respective rights-of-way.
   2. Obtain necessary permits for filling activities off Site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Approval Required: All material shall be subject to the approval of Engineer or independent testing laboratory.
   2. Notification: For approval of imported material, notify Engineer or independent testing laboratory at least 1 week in advance of intention to import material, designate the proposed borrow area, and permit Engineer or independent testing laboratory to sample as necessary from the borrow area for the purpose of making acceptance tests to prove the quality of the material.

B. Material Sources and Uses:
   1. Imported Material:
      a. Fill in undercut.
      b. Fill below structures, utility structures, or driving surfaces.
      c. Stone stabilization course.
      d. Fill for special soil construction such as earth berms, earth ponds, soil liners.
   2. Native material, unless quantity is not sufficient; then shall be imported material.
      a. Fill not below structures, utility structures, or driving surfaces.
      b. Topsoil.

C. Fill In Undercut: MDOT 902, Granular Material Class II.

D. Fill below structures, utility structures, or driving surfaces: MDOT 902, Granular Material Class II.

E. Stone Stabilization Course:
   1. Crushed Stone: 1-1/2 inches maximum size.
   2. Filter Fabric:
      a. By Mirafi; Amoco; Exxon; Nicolon; or equal.
      b. Monofilament polypropylene woven fabric.
      c. Equivalent opening size of 70.

F. Fill Not Below Structures, Utility Structures, or Driving Surfaces:
   1. Native material.
   2. Exclusive of gray or blue clay, peat, organic matter, or frozen lumps.
   3. Containing no rocks or lumps over 3 inches in greatest dimension.
   4. Obtain approval for using native material as fill from Engineer or independent testing laboratory.

G. Topsoil:
   1. Fertile, friable soil, containing a minimum of 2.5% and maximum 12% of organic matter as determined by the Loss on Ignition Test, AOAC, with not more than 50% clay and not more than 55% sand as determined in accordance with ASTM D422.
   2. At least 90% of the material shall pass the No. 10 sieve.
   3. Topsoil shall be free of refuse or all material toxic to plant growth. Ensure that the topsoil is contamination-free and clean at the source prior to transport to Site.
   4. Topsoil shall be free of subsoil and stumps, roots, brush, stones or similar objects larger than 1-inch diameter.
   5. Ordinary sods and herbaceous growth, like grass, need not be removed, but shall be thoroughly broken up and intermixed with soil during handling operations.
   6. Topsoil, unless otherwise specified or approved, shall have, according to Methods of Testing by the AOAC, acidity range of approximately 5.5 pH to 7.6 pH or as approved by Engineer prior to delivery.

H. Fill for Special Soil Construction, Such as Earth Berms, Earth Ponds, Soil Liners, Etc.:
   1. Clay with a unified soil classification of ML, CL or CH in accordance with ASTM D2487.
   2. Compacted to permeability of 1 x 10-7 cm/sec.

2.2 OTHER MATERIALS

A. All other materials, not specifically described but required for proper completion of the work of this Section, shall be as selected by Contractor subject to the approval of Engineer or independent testing laboratory.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Topsoil:
   1. Remove all topsoil to depth at which subsoil is encountered, from all areas under buildings, driving surfaces, and from all areas which are to be cut to lower grades or filled.
   2. With Engineer's approval, topsoil to be used for finish grading may be stored on the Site.
   3. Other topsoil may be used for fill in noncritical areas with approval of Engineer.

B. Obstructions:
   1. Remove and dispose of buried trees, rocks, boulders, driving surfaces, pipes and the like, as required for the performance of the Work.
   2. Exercise care in excavating around catch basins, inlets, and manholes.
   3. Avoid removing or loosening castings or pushing dirt into utility structures.
   4. Repair or replace damaged or displaced castings; remove dirt entering utility structures during the performance of the Work at no additional cost to Owner.

C. Cutting Paved Surfaces and Similar Improvements:
   1. All cuts shall be a minimum of 1-foot wider than trench on each side. When the remaining width of paved surface is less than 4 feet, remove the entire paved surface.
   2. Before removing pavement, mark the pavement neatly, paralleling pipe lines and existing street lines. Space the marks the width of the trench.
   3. Concrete:
      a. Pavements: Saw cut if over 3 feet from expansion or construction joint, otherwise remove to joint.
      b. Sidewalks: Remove to joints.
      c. Curb and gutter: Remove to joints.
   4. Final surface Course Bituminous: Saw cut joints unless otherwise approved by Engineer.
   5. Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.
   6. Contractor may tunnel under curbs that are encountered. Replace curb disturbed by construction.
   7. Dispose of materials removed.

D. Utilities To Be Abandoned:
   1. When pipes, conduits, sewers, or other utilities or utility structures are removed from the excavation leaving dead ends in the ground, fully plug such ends with brick and mortar.
   2. Entirely remove abandoned utility structures unless otherwise specified or indicated on the Drawings.
   3. Remove from the excavation all materials which can be readily salvaged and store at a location designated by Owner.
   4. All salvageable materials will remain the property of Owner unless otherwise indicated by Owner.

E. Undercut:
   1. If soft material, which in the opinion of Engineer or independent testing laboratory is not suitable, is encountered below a structure, utility structure, or driving surface, Engineer may order the removal of this soft material and its replacement with specified material in order to make a suitable foundation for the construction of the structure, utility structure, or driving surface.
   2. All undercutting made at the order of Engineer will be paid for on the basis of the actual quantity of material excavated. Do not proceed further until instructions are received and necessary measurements made for purposes of establishing additional volume of excavation.
   3. No extra payment will be made if removal is required as a result of poor dewatering techniques.
   4. Undercutting which is specifically indicated on the Drawings or herein specified, shall be included in the base Bid.
   5. Soil removed may be used as fill in areas not below driving surfaces, structures, or utility structures.
   6. Compact subgrade at bottom of undercut prior to placing fill.
   7. Place and compact specified fill in undercut.
   8. Lateral extent of undercut shall be a horizontal distance equal to the depth of undercut below structure, utility structure, or driving surface.

F. Excavating:
   1. All excavation shall be by open cut from the surface except as herein specified or as indicated on the Drawings.
   2. If required because of excess water conditions, place stone stabilization course prior to proceeding with construction. Place filter fabric over stone stabilization course.

G. Rock Excavation:
   1. Notify Engineer prior to removal if rock is encountered.
   2. Where rock is encountered within the excavation, expose the surface of the rock sufficient to permit adequate measurements to be taken before the rock excavation is started.

3.2 FILL

A. General:
   1. Do not place fill until the subgrade been examined by Engineer or independent testing laboratory.
   2. Place fill in even layers not exceeding 10 inches in depth and thoroughly compact as herein specified.
   3. Do not place additional fill until compaction on a lift complies with specification requirements.
   4. If an analysis of the soil being placed shows a marked difference from 1 location to another, the fill being placed shall not be made up of a mixture of these materials.

5. Handle each different type of material continuously so that field control of moisture and density may be based upon a known type of material.
6. Do not place fill following a heavy rain without first making certain on isolated test areas that compaction can be obtained without damage to the already compacted fill.
7. Do not place fill on frozen subgrade.

B. Compaction:
1. Select compaction equipment to achieve the required compaction without damaging adjacent structures, utility structures, or driving surfaces.
2. Suggested Equipment Selections:
   a. If soil is predominantly granular, use pneumatic tired or vibratory drum rollers loaded to not less than 325 pounds in accordance with rated inch of tire width.
   b. For clay fills, compact each layer with sheepsfoot rollers. Rollers shall have staggered rows of feet projecting not less than 7 inches from drum and shall be loaded to produce at least 200 pounds per square inch of tamping area in contact with the ground.
   c. Compact around structures and utility structures with hand operated vibrating compactors for granular soils and Barco rammer type compactors for clay soils.

C. Moisture:
1. Compact all fill with the moisture content as specified.
2. If fill material is too wet, provide and operate approved means to assist the drying of the fill until suitable for compaction.
3. If fill material is too dry, provide and operate approved means to add moisture to the fill layers.

3.3 GRADING

A. General:
1. Perform all rough and finish grading required to attain the elevations indicated on the Drawings.
2. Perform rough grading to an accuracy of ± 0.10 feet.
3. Perform finish grading to an accuracy of ± 0.05 feet.
4. Comply with all excavating and fill requirements specified herein during grading operations.

B. Grading Around Buildings: Control the grading around buildings so the ground is pitched to prevent water from running into the excavated areas of a building or damaging other Site features.

C. Treatment After Completion of Grading:
1. After grading is completed, permit no further excavation, filling, or grading, except with the approval of Engineer.
2. Use all means necessary to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

D. Topsoil: All graded areas, outside of buildings and driving surfaces, shall receive 4 inches of topsoil.

3.4 EXCESS WATER CONTROL

A. Regulations and Permits: Comply with soil erosion control permits in accordance with Mich. P.A. 451, Part 91 of 1994, the Natural Resource and Environmental Protection Act, and all pertinent rules, laws, and regulations.

B. Unfavorable Weather:
1. Do not place, spread, or roll any fill material during unfavorable weather conditions.
2. Do not resume operations until moisture content and fill density are satisfactory to Engineer or independent testing laboratory.

C. Pumping and Drainage:
   1. Provide, maintain, and use at all times during construction adequate means and devices to promptly remove and dispose of all water from every source entering the excavations or other parts of the Work.
   2. Dewater by means which will ensure dry excavations, preserve final lines and grades, and do not disturb or displace adjacent soil. Use wells, portable pumps, temporary underdrains or other methods as is necessary.
   3. Perform Pumping and Drainage:
      a. In such a manner to cause no damage to property or structures and without interference to the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other contractors.
      b. In accordance with all pertinent laws, rules, ordinances and regulations.
   4. Do not overload or obstruct existing drainage facilities.
   5. Provide berms or channels to prevent flooding of subgrade. Promptly remove all water collected in depressions.

3.5 DISPOSAL OF EXCESS EXCAVATED MATERIAL

A. General:
   1. Remove and properly dispose of all excavated material not needed to complete filling and grading.
   2. Dispose of excess excavated material at a location off the Site.
   3. Dispose of excess topsoil at a location off the Site.
   4. Disposal of all materials shall not violate laws, rules, regulations and the like regarding the filling of flood plains, wetlands and other environmentally sensitive areas.
   5. Provide adequate controls to maintain disposal sites in a neat and safe conditions by periodic leveling of material and such other practices as are necessary.
   6. Provide all soil erosion control measures necessary to prevent soil erosion and sedimentation of wetlands, rivers, ditches, or similar low lying areas.

3.6 CLEANUP

A. Upon completion of the work of this Section, remove all excess excavated material, trash, and debris resulting from construction operations. Remove equipment and tools. Leave the Site in a neat and orderly condition acceptable to Engineer, and in accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 31 22 00

SECTION 312216 - FINE GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and General and Supplemental Requirements which are hereby made a part of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of fine grading is shown on drawings and by provision of this section.

B. Type of work required includes the following:

1. Verification of rough grades established
2. Excavation as required
3. Fine grading
4. Compaction
5. Correction of grade, if required
6. Cleaning

C. Related work specified elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 PROJECT CONDITIONS:

A. The Contractor shall visit the site and review all existing conditions. The Contractor shall be responsible for his own subsurface investigations, as necessary, to satisfy requirements of this section. All subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Owner's Representative and Landscape Architect.

B. Obtain drawings showing proposed final grading.

C. Major demolition, site preparation and general site earthwork will be accomplished under another, earlier contract. Verify that sub-grade elevations established under that contract are within (1) inch above or below sub-grade requirements as outlined below. If sub-grade elevations are within tolerance, the Landscape Contractor shall make whatever adjustments are necessary to provide finish grades consistent with the requirements of the grading drawings and specifications.

D. Sub-Grade Elevations: Under a previous contract, sub-grade elevations are required to be established to within (1) inch of the following requirements.

1. Seeded and Sodded Lawn:
   a. 2" of topsoil (by Landscape Contractor); sub-grade elevation shall be held 3" below designed finish grade for sodded lawn areas and 2" below finish grade for seeded lawns.
   b. 4" of topsoil (by Landscape Contractor); sub-grade elevation shall be held 5" below designed finish grade for sodded lawn areas and 4" below finish grade for seeded lawns.

E. Before starting site operations verify that earlier Contractor's have disconnected all temporary utilities which might interfere with the fine grading work.

F. Locate all existing, active utility lines traversing the site and determine the requirements for their protection. Preserve in operating condition all active utilities adjacent to or transversing the site that are designated to remain.

G. Observe rules and regulations governing respective utilities in working under requirements of this section. Adequately protect utilities from damage, remove or relocate as indicated, specified or required. Remove, plug or cap inactive or abandoned utilities encountered in excavation. Record location of active utilities.

H. Dust Control: Use all means necessary to prevent dust from construction operations from being a nuisance to adjacent property Owner's and from damaging finish surfaces on adjacent building, paving, etc. Methods used for dust control are subject to approval by the Owner's Representative.

I. Protection: Use all means necessary to protect curbs, gutters, sprinklers, utilities and vegetation designated to remain, and, in the event of damage, immediately make all repairs, replacements and dressings to damaged plants necessary to the approval of the Owner's Representative and Landscape Architect. The Contractor shall incur all cost for the replacement of damaged objects and vegetation.

J. Maintain grade stakes set by others until parties concerned mutually agree upon removal.

K. Schedule all work in a careful manner with all necessary consideration for adjoining property Owner's and the public.

L. Coordinate schedule with other Contractor's to avoid conflicts with their work.

1.4 QUALITY ASSURANCE:

A. Requirements of all applicable building codes and other public agencies having jurisdiction upon the work.

B. Primary emphasis should be given to the aesthetic appearance and functioning of berming and swales, as directed by the Owner's Representative and Landscape Architect. The Contractor shall employ skilled personnel and any necessary equipment to insure that finish grading is smooth, aesthetically pleasing, drains well and is ideal for receiving sod and plant materials.

PART 2 - MATERIALS

2.1 EXISTING SOIL:

A. Use on-site material, unless otherwise directed by Owner's Representative and Landscape Architect, free from debris, sod, biodegradable materials and other deleterious materials. The Contractor shall insure that all existing soil has sufficient percolation and surface drainage to support grasses and plant material and that extreme compaction occurs only in areas to receive paving.

B. In areas to receive sod or seeded lawn, verify that soil is scarified to depth of 4" to support and encourage rooting.

PART 3 - EXECUTION

3.1 EXCAVATION:

A. Excavate where necessary to install conduit, subsurface drainage pipe and materials and planting mix, or to enhance, percolation and surface drainage as required.

B. Materials to be excavated are unclassified.

C. Remove entirely any existing obstructions after approval by the Owner's Representative and Landscape Architect.

D. Remove from site and dispose of debris and excavated material not required.

3.2 FINE GRADING:

A. The Contractor shall establish finished grades as shown on the landscape plan and or grading plan or as directed by the Owner's Representative and Landscape Architect, including areas where the existing grade has been disturbed by other work.

B. Grade the finish surface of all planted areas to meet the grades shown on the drawings, allowing the finished grades to remain higher than the grades on the grading plan to accomodate settlement over the first year. The Contractor is responsible to provide the finished grades as shown on the grading plans at end of the one year warranty and is responsible at his expense for all repair work as required to provide these grades.

C. Utilize hand equipment, small garden tractors with rakes, or small garden tractors with buckets with teeth for fine grading to keep surface rough without further compactions. Do not use the flat bottom of a loader bucket to fine grade, as it will cause the finished grade to become overly smooth and or slightly compressed.

D. Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify the owner's representative in the event that conditions make it impossible to achieve positive drainage.

E. Finished grading shall be smooth, aesthetically pleasing, drain well and ready to receive lawn and other plant material to full satisfaction of the Owner's Representative and Landscape Architect.

F. Fill all dips and remove any bumps in the overall plane of the slope. The tolerance for dips and bumps in plant beds shall be a 2 inch deviation from the plane in 10 feet. The tolerance for dips and bumps in lawn areas shall be a 1 inch deviation from the plane in 10 feet.

3.3 COMPACTION:

A. Compact each layer of fill in designated areas with approved equipment to achieve a maximum density at optimum moisture, AASHTO T 180 - latest edition.

1. Under landscaped areas, compaction shall be 80-85% of maximum density.

B. No backfill shall be placed against any masonry or other exposed building surface until permission has been given by the Owner's Representative and Landscape Architect, and in no case until the masonry has been in place seven (7) days.

C. Compaction in limited areas shall be obtained by the use of mechanical tampers or approved hand tampers. When hand tampers are used, the materials shall be deposited in layers not more than four inches thick. The hand tampers used shall be suitable for this purpose and shall have a face area of not more than 100 square inches. Special precautions shall be taken to prevent any wedging action against masonry or other exposed building surfaces.

3.4 CORRECTION OF GRADE:

A. Bring to required grade levels areas where settlement, erosion or other grade changes occur. Adjust grades as required to provide positive drainage away from buildings and to prevent ponding around the buildings and on pavements.

B. Remove all rock or objectionable material larger than 1" in any direction prior to commencing landscaping.

C. The Contractor shall be responsible for stabilizing grades by approved methods prior to landscaping, and shall be responsible for correction of grades as mentioned above, and clean up of any wash outs or erosion.

3.5 CLEANING:

A. All areas over which hauling operations have been conducted shall be kept clean on a daily basis. Promptly remove materials spilled on pavement.

B. Upon completion of fine grading, remove from the site and legally dispose of all trash and debris including any material removed during grade preparation.

C. Restore existing areas damaged by operations under the contract. Restoration shall include fine grading as required to match existing grade, landscape repair, and maintenance of restored areas.

END OF SECTION 312216

SECTION 31 23 03 – EXCAVATION AND FILL FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Excavation and trenching in earth and in rock.
   2. Disposal of items from clearing and unsuitable or excess excavated materials.
   3. Complete drainage of excavations.
   4. Temporary or permanent sheeting, bracing and shoring of excavations.
   5. Installation of normal and special foundations, bedding and backfill materials.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. D1556 – Density and Unit Weight of Soil In Place by the Sand-Cone Method.
      b. D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.
      c. D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
      d. D2922 – Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
   2. State DOT Current Standards:
      a. Specifications for Construction.
      b. Standard Plans.

1.4 DEFINITIONS

A. Terms:
   1. Bedding: The material placed around a utility between 4 inches below to 12 inches above the utility the full width of the trench.
   2. Driving Surface: A pavement, curb, or sidewalk.
   3. Excavation:
      a. Removing the following materials from their present location:
         1) Native below-grade material such as soil, rocks, boulders less than 1/2 cubic yard in volume, and buried trees.
         2) Man-made items such as, but not necessarily limited to:
            a) Bituminous and concrete paving.
            b) Curbs.
            c) Riprap.
            d) Head walls.
            e) Underground utilities.
            f) Manholes and catch basins.
            g) Foundations.
            h) Sidewalks.
   4. Extra Earth Excavation: Excavation of native material from below the normal trench bottom.
   5. Foundation Material: The material placed in a trench undercut to replace extra earth excavation.
   6. Hardpan:
      a. Cemented soil layers.
      b. Is not hard clay layers that are not cemented.
   7. Imported Material: Soil material which is purchased by Contractor and hauled onto the Site.
   8. Native Material: Soil and other natural earth materials, except rock, which are existing on the Site prior to the start of Work.

9. Normal Trench Bottom: The surface of the undisturbed native material at an elevation 4 inches below the bottom of the utility.
10. Pavement: Any combination of subbase, base course and concrete, bituminous or aggregate surface course, including shoulders, placed on a subgrade. Includes roadways, parking areas, driveways, and bituminous seal coat.
11. Rock Excavation:
    a. Excavation of igneous, metamorphic or sedimentary rock or hardpan which cannot be excavated without continuous drilling and blasting or continuous use of a ripper or other special equipment.
    b. Excavation of boulders of 1/2 cubic yard or more in volume.
12. Special Foundations:
    a. Specially constructed systems for support of underground utilities such as timber piling, concrete foundations and surcharge techniques.
    b. Extra earth excavation and placing imported or native materials are not special foundations.
13. Structure: A building, retaining wall, tank, footing, slab, or other similar construction.
14. Suitable Material:
    a. Native material excavated from the trench and approved as backfill by Engineer or independent testing laboratory.
    b. Not used under or within 1 on 1 slope of driving surfaces or structures.
    c. Placed between the top of the bedding or trench backfill as indicated on the Drawings and the bottom of the surface restoration.
15. Trench Backfill:
    a. The material placed between the top of bedding and the bottom of suitable material, the surface restoration or driving surface, as indicated on the Drawings.
    b. Used under and within 1 on 1 slope of driving surfaces or structures.
16. Utility Structure: Manhole, catch basin, valve chamber, junction chamber, water main valve, or other similar utility appurtenance.
17. Other Definitions: Other earthwork terms not defined herein or in the Contract Documents shall be as defined in state DOT Standard Specifications for Construction.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Trench Bottom Suitability:
1. Be responsible for the suitability of the normal trench bottom in supporting the utility, bedding and backfill.
2. Notify Engineer and await Engineer's decision if a possible unsuitable condition exists.
3. Poor dewatering techniques or lack of excess water control shall not be a reason for additional payment for remedial measures.

B. Trench Wall Stability:
1. Be responsible for the trench configuration, including sheeting, shoring and bracing necessary to support trench side walls from collapsing.
2. Be responsible for the structural design and stability of a pipe-laying box if utilized on the Project to prevent trench walls from collapsing.

1.6 QUALITY ASSURANCE

A. Testing: Testing will be performed in accordance with Division 01 Section "Testing Services for Buried Utilities, Roadways, and Site Projects." and the Contractor’s Quality Control Plan.

B. Compaction:
1. Determine density by the modified Proctor method, ASTM D1557.
2. Compact granular trench backfill and bedding to at least 95% maximum density.
3. Compact suitable backfill material to at least 90% maximum density.
4. The first 12 inches of native material at the bottom of utility trenches:
    a. Test for density.
    b. Compact to at least 95% maximum density (modified proctor) if the existing density is below 95% maximum density (MP).
    c. Compact clay soil to at least 98% maximum density in accordance with standard proctor ASTM D698, if below 98% maximum density (SP).

1.7 SUBMITTALS

A. Action Submittals: For imported materials:
   1. Source.
   2. State DOT classification.
   3. Sieve Analysis.

1.8 PROJECT CONDITIONS

A. Dust Control:
   1. Use all legal means necessary to control dust on and near the Work and on and near off-site borrow areas if such dust is caused by Contractor's operations during performance of the Work or if resulting from the condition of the Site when earthwork operations are suspended.
   2. Moisten or otherwise treat haul roads, delivery roads, temporary site access roads and other surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the Site.
   3. Scrape, broom, or vacuum adjacent streets to remove tracked dirt every Friday afternoon, or more as necessary if directed by Engineer. Utilize vacuum if dust from brooming is excessive in opinion of Engineer.

B. Existing Structures, Utility Structures, and Utilities:
   1. Call MISS DIG to locate existing underground utilities prior to starting excavation.
   2. Where utilities, utility structures or structures are encountered which are in active use:
      a. Provide adequate protection for them.
      b. Be responsible for damage to them.
   3. Provide stand-by utility service if temporary removal is necessary for a period exceeding 2 hours.
   4. Where utility service connections to occupied buildings must be temporarily disconnected, give 48 hours notice to the affected occupants of the time and duration of the anticipated shutoff.
   5. Notify Fire Department 48 hours in advance if water main or fire supply line shutoff is required.
   6. Raise, lower, or move underground utilities, utility structures or structures which interfere with the utility or utility structure being constructed as part of this Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Approval Required: Material shall be subject to the approval of Engineer or independent testing laboratory.
   2. Notification: For approval of imported material, notify Engineer or independent testing laboratory at least 1 week in advance of intention to import material, designate the proposed borrow area, and permit Engineer or independent testing laboratory to sample as necessary from the borrow area for the purpose of making acceptance tests to prove the quality of the material.

B. Material Sources and Uses:
   1. Imported Material:
      a. Foundation material.
      b. Bedding.
      c. Pea stone.
      d. Trench backfill.
   2. Native material unless quantity is not sufficient; then shall be imported material: Suitable material.

C. Foundation Material for Crushed Stone: 1-1/2-inch maximum size.

D. Bedding:
   1. For Pipes Less Than 36 Inches:
      a. MDOT 902 Granular Material Class II modified to 100% passing a 1/2-inch sieve.
      b. MDOT 902 Coarse Aggregate 17A.

2. For Pipes 36 Inches and Larger:
   a. Pea stone bedding to spring line.
   b. Geotextile filter fabric over pea stone.
   c. MDOT Granular Material Class II to 1 foot above pipe.
3. For Utility Structures:
   a. Sand gravel fill of such gradation that 100% will pass a 1/2-inch sieve and not more than 10% by weight is lost by washing, or
   b. MDOT 902 Granular Material Class II modified to 100% passing a 1/2-inch sieve.

E. Pea Stone: Clean stone with 100% passing a 3/8-inch sieve and 100% being retained on a No. 8 sieve.

F. Trench Backfill: MDOT 902 Granular Material Class II.

G. Suitable Material:
1. Native Material Which is Used as Backfill:
   a. Exclusive of gray or blue clay, peat, organic matter, or frozen lumps.
   b. Containing no rocks or lumps over 3 inches in greatest dimension.
   c. Having a moisture content such that material is capable of being compacted to 90% maximum density.
2. MDOT 902 Granular Material Class II if native material is not adequate in opinion of Engineer.

H. Special Foundations:
1. Only if approved by Engineer.
2. MDOT 601 Grade P2 concrete.
3. MDOT 601 912.07 timber piles.

I. Concrete Encasement of Utilities:
1. Only as indicated on the Drawings.
2. MDOT Grade M.

2.2 OTHER MATERIALS

A. Other materials, not specifically described but required for proper completion of the work of this Section, shall be as selected by Contractor subject to the approval of Engineer or independent testing laboratory.

PART 3 - EXECUTION

3.1 GENERAL

A. Excavating, Backfilling and Compacting:
1. For Structures: In accordance with Division 31 Section “Excavation and Fill for Structures.”
2. For Utility Structures: In accordance with this Section.

B. Obstructions:
1. Remove and dispose of buried trees, rocks, boulders, driving surfaces, pipes and the like, as required for the performance of the Work.
2. Exercise care in excavating around catch basins, inlets and manholes.
3. Avoid removing or loosening castings.
4. Repair and replace damaged or displaced castings; remove dirt entering utility structures during the performance of the Work at no additional cost to Owner.

C. Cutting Paved Surfaces and Similar Improvements:
1. Cut pavement prior to excavating.
2. Cuts shall be a minimum of 1-foot wider than trench on each side. When the remaining width of paved surface is less than 4 feet, remove the entire paved surface.
3. Before removing pavement, mark the pavement neatly, paralleling pipe lines and existing street lines. Space the marks the width of the trench.

4. Concrete:
   a. Pavements: Saw cut if over 3 feet from expansion or construction joint, otherwise remove to joint.
   b. Sidewalks: Remove to joints.
   c. Curb and Gutter: Remove to joints.
5. Final Surface Course Bituminous: Saw cut joints unless otherwise approved by Engineer.
6. Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.
7. Contractor may tunnel under curbs that are encountered. Replace curb disturbed by construction.
8. Dispose of materials removed.

D. Utilities to be Abandoned:
1. When pipes, conduits, sewers or utility structures are removed from the trench leaving dead ends in the ground, fully plug such ends with brick and mortar.
2. Entirely remove abandoned utility structures unless otherwise specified or indicated on the Drawings.
3. Remove from the excavation materials which can be readily salvaged and store on the Site.
4. Salvageable materials will remain the property of Owner unless otherwise indicated by Owner.

E. Extra Earth Excavation:
1. If soft material, which in the opinion of Engineer or independent testing laboratory is not suitable, is encountered below the normal trench bottom or below a utility structure Engineer may order the removal of this soft material and its replacement with specified material in order to make a suitable foundation for the construction of the utility or utility structure.
2. Extra earth excavation made at the order of Engineer will be paid for on the basis of the actual quantity of material excavated. Do not proceed further until instructions are received and necessary measurements made for purposes of establishing additional volume of excavation.
3. No extra payment will be made if removal is required as a result of poor dewatering techniques.
4. Special foundations shall be determined on an individual basis by Engineer in cooperation with Contractor, unless otherwise provided in the Contract Documents.

3.2 EXCAVATION AND TRENCHING

A. General:
1. By open cut from surface unless designated otherwise.
2. Slope sides of trench adequately for protection of the Work and safety of workers.

B. Maximum Length of Open Trench: 200 feet.

C. Width:
1. Minimum Clearance on Each Side of Utility:
   a. To 16 Inches Diameter: 8 inches.
   b. Greater Than 16 Inches Diameter: Pipe outside diameter times 1.25 plus 12 inches.
2. Maximum Width of Trench at Top of Bedding:
   a. Up Through 30-Inch Diameter Utility: 16 inches plus utility diameter.
   b. Greater Than 30-Inch Diameter Utility: 24 inches plus utility diameter.
3. Maximum Width of Trench at Ground Surface:
   a. Not outside of the property line or easement.
   b. As required for protection of the Work and safety of workers.
   c. Use sheeting, bracing and shoring if required.
4. Provide sufficient space in the trench to permit the joint to be properly made.

D. Depth:
1. Excavate to provide the elevations, grades, and depths of cover indicated on the Drawings and herein specified.
2. The 4 inches of required bedding material below the utility may be omitted if:
   a. Approved by Engineer.
   b. Contractor arranges and pays for testing of the native material.
   c. The native material complies with MDOT 902 Granular Material Class II material, modified so that 100% passes a 1/2-inch sieve.
   d. The material is compacted as specified herein.
3. Excavate to the normal trench bottom elevation with an accuracy of ± 0.10 feet.

E. Rock Excavation:
   1. Where rock excavation is encountered within the excavation, expose the surface of the rock sufficient to permit adequate measurements to be taken before the rock excavation is started.
   2. Notify Engineer prior to removal if rock is encountered.
   3. No utility shall be within 6 inches of rock.
   4. Blasting:
      a. Only with permission of Engineer and in accordance with laws and regulations applying thereto.
      b. Secure permit if required.
      c. Notify utility and public agencies.
      d. Explosives shall be used with extreme care by experienced workers only.
      e. Hours shall be fixed by Engineer.
      f. Contractor solely responsible for safety, damage and control of blasting operations.

F. Bedding:
   1. Place the bedding material up to 1/8 the height of the utility. Compact as herein specified.
   2. Accurately shape the bedding material to fit the pipe shape. Recess the bedding to relieve the pressure on the bell or other projecting utility joint.
   3. After laying out the utility, tamp additional bedding in place up to the midpoint of the utility. Use hand-operated compactors to achieve the required compaction.
   4. Place additional bedding up to 12 inches above the top of the utility. Use hand operated compactors to achieve required compaction.
   5. Place bedding in maximum lifts of 10 inches.
   6. No payment shall be made for aggregate or stone bedding when used for Contractor convenience.
   7. Provide concrete encasement at utilities so indicated on the Drawings.

G. Trench Backfill:
   1. Use backfill material as each Drawing detail indicates and as the material is defined herein.
   2. Place backfill in 12-inch lifts and compact as herein specified. Engineer will consider greater lifts if testing indicates that the required compaction is being achieved.

H. Utility Structures:
   1. Place and compact specified bedding below utility structures.
   2. Backfill around utility structures shall be of the same type backfill as that required for the trench in accordance with these Contract Documents.
   3. Place backfill in 12-inch lifts and compact as herein specified.

3.3 DISPOSAL OF EXCESS EXCAVATED MATERIAL

A. General: Contractor responsibility and expense.

B. Disposal Sites:
   1. Material desired by Owner shall be disposed of by Contractor in the following priority order:
      a. At locations designated by the Contract Documents.
      b. At locations on or within 2 miles of the Project Site designated by Owner after construction starts.
      c. At locations on the Project Site by written arrangement with individual property owners.
      d. Owner may choose not to accept certain materials, including but not necessarily limited to, items from clearing, muck, peat, marl and whole or broken man-made items removed by construction.
   2. Material not desired by Owner shall be disposed of in a location determined by Contractor.
   3. Disposal of materials shall not violate laws, rules, regulations and the like regarding the filling of flood plains, wetlands and other environmentally sensitive areas.
   4. Provide adequate controls to maintain disposal sites in a neat and safe condition by periodic leveling of material, and such other practices as are necessary.
   5. Provide soil erosion control measures necessary to prevent soil erosion and sedimentation of wetlands, rivers, ditches, or similar low lying areas.

3.4 EXCESS WATER CONTROL

A. Regulations and Permits: Comply with soil erosion control permit in accordance with Mich. P.A. 451, Part 91 of 1994, the Natural Resource and Environmental Protection Act, and all pertinent rules, laws, and regulations.

B. Unfavorable Weather:
   1. Do not place, spread or roll fill material during unfavorable weather conditions.
   2. Do not resume operations until moisture content and fill density are satisfactory to Engineer or independent testing laboratory.

C. Pumping and Drainage:
   1. Provide, maintain and use at all times during construction adequate means and devices to promptly remove and dispose of water from every source entering the excavations or other parts of the Work.
   2. Dewater by means which will ensure dry excavations, preserve final lines and grades, and do not disturb or displace adjacent soil. Use wells, portable pumps, temporary underdrains, or other methods as necessary.
   3. Perform Pumping and Drainage:
      a. In such a manner to cause no damage to property or structures and without interference to the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other contractors.
      b. In accordance with pertinent laws, rules, ordinances, and regulations.
   4. Do not overload or obstruct existing drainage facilities.

D. General:
   1. Keep excavations dry during construction.
   2. Remove water by use of wells, well points, portable pumps, bailing, drains, underdrains or other acceptable methods.
   3. Provide crushed stone or gravel as required to aid dewatering operations.
   4. Divert or temporarily reroute existing sewers and drainage of discharge lines to adequate and acceptable outlets during construction. Contractor responsible to ascertain availability of outlets.
   5. Divert surface water from entering excavations by construction and maintenance of channels or berms.
   6. Sediment traps and other soil erosion control measures shall prevent soil particles from entering any sewer, watercourse or similar conveyance.
   7. Protect utilities, utility structures, and structures, existing and new, from hydrostatic uplift.

3.5 SHEETING, SHORING AND BRACING EXCAVATIONS

A. General:
   1. Furnish, put in place and maintain sheeting, bracing and shoring as may be required to properly support the sides of excavations and to prevent movement of earth which could in any way injure the Work or adjacent property.
   2. Exercise care in the removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of the excavation faces being supported and damage to the Work and adjacent property.
   3. A pipe-laying box may be used in lieu of sheeting.

B. Sheeting:
   1. Do not install by jetting.
   2. Remove as backfilling proceeds, unless ordered left in place by Engineer. Use care to fill and compact voids created by removal, especially below mid-height of utility.
   3. Sheeting Left in Place:
      a. Requires written approval of Engineer.
      b. Cut off minimum of 2 feet below finished grade.

3.6 CLEANUP

A. Upon completion of the work of this Section, remove all excess excavated material, trash, and debris resulting from construction operations. Remove equipment and tools. Leave the Site in a neat and orderly condition acceptable to Engineer, and in accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 31 23 03

SECTION 31 23 06 – EXCAVATION AND FILL FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Excavation.
   2. Backfilling.
   3. Proof rolling.
   4. Sheeting.
   5. Bracing.
   6. Shoring.
   7. Disposal of excavated materials.
   8. Excess water control.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standards:
      a. D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort.
      b. D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.
   2. MDOT:
      a. 2003 Standard Specifications for Construction.
      b. Standard Plans.

1.4 DEFINITIONS

A. Terms:
   1. Driving Surface: A pavement, curb, or sidewalk.
   2. Excavation:
      a. Removing the following materials from their present location:
         1) Native below-grade material such as soil, rocks, boulders less than 1/2 cubic yard in volume, and buried trees.
         2) Man-made items such as, but not necessarily limited to:
            a) Bituminous and concrete paving.
            b) Curbs.
            c) Riprap.
            d) Head walls.
            e) Underground utilities.
            f) Manholes and catch basins.
            g) Foundations.
            h) Sidewalks.
   3. Fill: Imported material, or where allowed native material, which is placed in structure undercut.
   4. Hardpan:
      a. Cemented soil layers.
      b. Is not hard clay layers that are not cemented.
   5. Imported Material: Soil material which is hauled onto the Site from an off-Site location.
   6. Native Material:
      a. Soil and other natural earth materials, except rock, which are existing on the Site prior to the start of Work.
      b. Also called overexcavation.

7. Pavement: A combination of subbase, base course, and concrete, bituminous or aggregate surface course, including shoulders, placed on a subgrade. Includes roadways, parking areas, driveways, and bituminous seal coat.
8. Rock Excavation:
   a. Excavation of igneous, metamorphic, or sedimentary rock or hardpan which cannot be excavated without continuous drilling or blasting or continuous use of a ripper or other special equipment.
   b. Excavation of boulders of 1/2 cubic yard or more in volume.
9. Structure: A building, retaining wall, tank, footing, slab, or other similar construction.
10. Structure Backfill: Soil or other material which is placed against walls or sides of structures.
11. Subbase: The layer of material placed on the subgrade as part of the pavement structure.
12. Subgrade:
   a. Below structures and below fill on the Site: The top elevation of the undisturbed native material after topsoil is stripped off and excavation is completed.
   b. Below driving surfaces: The bottom elevation of the subbase.
13. Undercut: Excavation of native material from below the bottom of footings, floors, structures, and subbases.
14. Utility Structures: Manhole, catch basin, valve chamber, junction chamber, water main valve, or other similar utility appurtenance.
15. Other Definitions: Other earthwork terms not defined in the Contract Documents shall be as defined in MDOT Standard Specifications for Construction.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Excavation Side Stability:
   1. Be responsible for the structural design of sheet piling, underpinning, shoring, and bracing to prevent sides of excavation from collapsing and causing damage to adjacent structures, pavements, and materials.

1.6 QUALITY ASSURANCE

A. Perform special inspections in accordance with Division 01 Section “Special Inspections and Tests.”

B. Compaction:
   1. Predominately Granular Soils:
      a. Determine density using the modified Proctor method, ASTM D1557.
      b. Compact fill and backfill to at least 95% maximum density.
      c. The first 12-inches of subgrade below structures, fill and backfill on the Site:
         1) Test for density.
         2) Compact to at least 95% maximum density if the existing density is below 95%.
   2. Predominately Cohesive Soils:
      a. Determine density using the standard Proctor method, ASTM D698.
      b. Compact fill and backfill to at least 95% maximum density.
      c. The first 12-inches of subgrade below all structures, fill, and backfill on the Site:
         1) Test for density.
         2) Compact to at least 95% maximum density if the existing density is below 95%.

1.7 PROJECT CONDITIONS

A. Dust Control:
   1. Use legal means necessary to control dust on and near the Work and on and near off-Site borrow areas if such dust is caused by Contractor's operations during performance of the Work or if resulting from the condition of the Site when earthwork operations are suspended.
   2. Moisten or otherwise treat haul roads, delivery roads, temporary site access roads and other surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the Site.
   3. Scrape, broom, or vacuum adjacent streets to remove tracked dirt every Friday afternoon, or more often as necessary if directed by Engineer.
   4. Utilize vacuum if dust from brooming is excessive in opinion of Engineer.

B. Existing Structures, Utility Structures, and Utilities:
   1. Call MISS DIG to locate existing underground utilities prior to starting excavation.
   2. Where utilities, utility structures, or structures are encountered which are in active use:
      a. Provide adequate protection for them.
      b. Be responsible for damages to them.
   3. Provide stand-by utility service if temporary removal is necessary for a period exceeding 2 hours.
   4. Where utility service connections to occupied buildings must be temporarily disconnected, give 48 hours' notice to the affected occupants of the time and duration of the anticipated shutoff.
   5. Notify Fire Department 48 hours in advance if water main or fire supply line shutoff is required.
   6. Raise, lower, or move underground utilities, utility structures, or structures which interfere with the structure being constructed as part of this Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Material: Subject to the review of special inspector.
   2. For review of imported material, notify special inspector at least 1 week in advance of intention to import material, designate the proposed borrow area, and permit special inspector to sample as necessary from the borrow area for the purpose of making acceptance tests to prove the quality of the material.

B. Material Sources and Uses:
   1. Imported Material:
      a. Granular layers below floor slabs.
      b. Fill in structure undercut.
      c. Stone stabilization course below structures.
      d. Structure fill and backfill below structures and driving surfaces
      e. Structure backfill not below driving surfaces.
   2. Native material unless quantity or quality is not sufficient; then shall be imported material:
      a. None.

C. Granular Layer Below Floor Slabs: ASTM C33-5S, Number 57 (1-inch).

D. Fill In Structure Undercut: MDOT 902, Granular Material Class II.

E. Structure Fill and Backfill Below Structures and Driving Surfaces: MDOT 902, Granular Material Class II.

F. Stone Stabilization Course:
   1. Crushed Stone: 1-1/2-inches maximum size.
   2. Filter Fabric:
      a. By US Fabrics; Geotex; Propex; or equal.
      b. Needlepunched polypropylene non-woven fabric.
      c. Weight: 6.0 oz./square yard, minimum.
      d. Equivalent Opening Size: 70 minimum.

G. Structure Backfill Not Below Driving Surfaces:
   1. Native material.
   2. Exclusive of gray or blue clay, peat, organic matter, or frozen lumps.
   3. Containing no rocks or lumps over 3 inches in greatest dimension.

2.2 OTHER MATERIALS

A. Other materials, not specifically described but required for proper completion of the work of this Section, shall be as selected by Contractor subject to the review of special inspector.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, Backfilling, and Compacting:
   1. For Structures: In accordance with this Section.
   2. For Utility Structures: In accordance with Division 31 Section "Excavation and Fill for Utilities."

B. Bracing and Sheeting:
   1. Do not install by jetting.
   2. Furnish, put in place, and maintain sheeting, bracing, and shoring as may be required to properly support the sides of excavations and to prevent movement of earth which could injure the Work or adjacent property.
   3. Exercise care in the removal of sheeting, shoring, bracing, and timbering to prevent collapse or caving of the excavation faces being supported and damage to the Work and adjacent property.
   4. Do not leave sheeting or bracing in the excavation after completion of the Work, unless reviewed by Engineer.

C. Obstructions: Remove and dispose of buried trees, rocks, boulders, driving surfaces, pipes, and the like, as required for the performance of the Work.

D. Cutting Paved Surfaces and Similar Improvements:
   1. Cuts: A minimum of 1-foot wider than excavation on each side.
   2. When the remaining width of paved surface is less than 4 feet, remove the entire paved surface.
   3. Before removing pavement, mark the pavement neatly.
   4. Concrete:
      a. Pavements: Saw cut if over 3 feet from expansion or construction joint, otherwise remove to joint.
      b. Sidewalks: Remove to joints.
      c. Curb and Gutter: Remove to joints.
   5. Final Surface Course Bituminous: Saw cut joints unless otherwise reviewed by Engineer.
   6. Do not disturb or damage the adjacent pavement.
   7. If the adjacent pavement is disturbed or damaged, remove the damaged pavement and place new pavement of a type that matches the existing.
   8. Tunneling under curbs that are encountered is permitted, however, place new curb where existing curb is disturbed by construction.
   9. Dispose of materials removed.

E. Undercut:
   1. If suitable bearing for foundations is not encountered at the elevations indicated on the Drawings immediately notify Engineer.
   2. If soft material, which in the opinion of special inspector is not suitable, is encountered below a structure, Engineer may order the removal of this soft material and its replacement with specified material in order to make a suitable foundation for the construction of the structure.
   3. Undercutting made at the order of Engineer will be paid for on the basis of the actual quantity of material excavated.
   4. Do not proceed further until instructions are received and necessary measurements made for purposes of establishing additional volume of excavation.
   5. No extra payment will be made if removal is required as a result of poor dewatering techniques.
   6. Include undercutting which is specifically indicated on the Drawings or herein specified in the base Bid.
   7. Soil removed may be used as fill or backfill in areas not below driving surfaces, structures, or utility structures.
   8. Compact subgrade at bottom of undercut prior to placing fill.
   9. Place and compact specified fill in undercut.
   10. Lateral Extent of Undercut: A horizontal distance equal to the depth of undercut below structure.

F. Proof-Rolling:
   1. Proof-roll exposed subgrade of structure footprint in the presence of the special inspector.
      a. Provide loaded heavy rubber-tired dump truck, or similar, and labor for proof-rolling.
   2. In subgrade areas identified by the special inspector, provide compaction or replace unsuitable subgrade areas with specified fill.

G. Excavating:
   1. Perform excavation by open cut from the surface except as herein specified or as indicated on the Drawings.
   2. Perform excavations for structures in such manner and to such depth and width as will give ample room for building the structures and for bracing, sheeting, and supporting the sides of the excavation, for pumping and draining groundwater and wastewater which may be encountered, and for the removal of materials excavated.
   3. Excavate to the required cross section and elevation indicated in the Drawings.
   4. Subgrade Elevation: Within 0.1 feet above or below the established elevations.
   5. Fill depressions caused by excess excavation, traffic or rolling with specified fill, rerolled and compacted in place as specified herein.
   6. If required because of excess water conditions, place stone stabilization course prior to proceeding with construction.
      a. Place filter fabric over stone stabilization course.

H. Thermal Protection: Protect bottoms of excavations from frost and freezing.

3.2 COMPACTION

A. Select compaction equipment to achieve the required compaction without damaging adjacent structures.
   1. Suggested Equipment Selections:
      a. If soil is predominantly granular, use pneumatic tired or vibratory drum rollers loaded to not less than 325 pounds per rated inch of tire width.
      b. For Clay Soils:
         1) Compact each layer with sheepsfoot rollers.
         2) Utilize rollers with staggered rows of feet projecting not less than 7 inches from drum and loaded to produce at least 200 pounds per square inch of tamping area in contact with the ground.
      c. Compact around structures with hand-operated vibrating compactors for granular soils and Barco rammer type compactors for clay soils.

B. Moisture:
   1. Compact fill and backfill with moisture content of 2.0% below to 2.0% above optimum soil moisture content.
   2. If material is too wet, provide and operate reviewed means to assist the drying until suitable for compaction.
      a. If material is too dry, provide and operate reviewed means to add moisture to the layers.

3.3 FILL

A. General:
   1. Do not place fill until the subgrade been examined by special inspector.
   2. Place fill in even layers not exceeding 9 inches in depth and thoroughly compact as herein specified.
   3. Do not place additional fill until compaction on a lift complies with specification requirements.
   4. If an analysis of the soil being placed shows a marked difference from 1 location to another, do not use a mixture of those materials for the fill being placed.
   5. Handle each different type of material continuously and consistently so that field control of moisture and density may be based upon a known type of material.
   6. Do not place fill following a heavy rain without first making certain on isolated test areas that compaction can be obtained without damage to the already compacted fill.

3.4 STRUCTURE BACKFILL

A. General:
1. Remove debris from excavations before backfilling.
2. Do not backfill against foundation walls until:
   a. Reviewed by Engineer.
   b. Indicated perimeter insulation is in place.
3. Protect insulation and waterproofing, if any, during filling operations.
4. Wherever possible, backfill simultaneously on both sides of walls to equalize lateral pressures.
5. Do not backfill on only 1 side of vertically spanning walls unless walls are adequately shored, or permanent construction is in place to furnish lateral support on both top and bottom of wall.
6. Place backfill in layers not exceeding 9 inches in depth.
7. Do not place backfill on frozen subgrade.

3.5 EXCESS WATER CONTROL

A. Provide dewatering to permit construction as indicated on the Drawings and specified herein.

B. Regulations and Permits: Comply with soil erosion control permit in accordance with pertinent rules, laws, and regulations of the authority having jurisdiction.

C. Unfavorable Weather:
1. Do not place, spread, or roll material during unfavorable weather conditions.
2. Do not resume operations until moisture content and density are satisfactory to special inspector.

D. Pumping and Drainage:
1. Provide, maintain, and use adequate means and devices throughout the construction to promptly remove and dispose of water from every source entering the excavations or other parts of the Work.
2. Dewater by means which will ensure dry excavations, preserve final lines and grades, and do not disturb or displace adjacent soil.
3. Use wells, portable pumps, temporary underdrains, or other methods as is necessary.
4. Perform pumping and drainage:
   a. In such a manner to cause no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic, and the work of other contractors.
   b. In accordance with pertinent laws, rules, ordinances, and regulations.
5. Do not overload or obstruct existing drainage facilities.
6. Provide berms or channels to prevent flooding of subgrade.
7. Promptly remove water collected in depressions.
8. Ensure water is removed prior to placing concrete; do not place concrete into standing water.

3.6 DISPOSAL OF EXCESS EXCAVATED MATERIAL

A. General:
1. Remove and properly dispose of excavated material not needed to complete filling and backfilling.
2. Dispose of excess excavated material at a location off the Site.
3. When disposing materials, do not violate laws, rules, regulations, and the like regarding the filling of flood plains, wetlands, and other environmentally sensitive areas.
4. Provide adequate controls to maintain disposal sites in a neat and safe condition by periodic leveling of material and such other practices as are necessary.
5. Provide soil erosion control measures necessary to prevent soil erosion and sedimentation of wetlands, rivers, ditches, or similar low-lying areas.

3.7 CLEANING

A. Upon completion of the work of this Section, remove excess excavated material, trash, and debris resulting from construction operations.
   1. Remove equipment and tools.
   2. Leave the Site in a neat and orderly condition acceptable to Engineer, and in conformance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 31 23 06

SECTION 31 25 00 – EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing, installation and maintenance of soil erosion and sedimentation control (SESC) measures.
   1. Minimum SESC measures/Best Management Practices (BMP) are indicated on the Drawings. These measures are to be installed correctly before any grading or excavating begins on the Site. Contractor should add additional BMP's as required by their operations, such as temporary stock piles, equipment storage etc.
   2. Stage Construction and stabilization activities to minimize the amount of disturbed area at any one time.
   3. Remove sediment caused by erosion from storm water before it leaves the Site or enters waters of the state.
   4. Place soil piles away from drainage courses. Soil piles must be protected from precipitation and wind with non-erosive covers or other BMP's.
   5. Provide anti-tracking areas for haul roads and equipment. Sweep streets, parking areas regularly as needed.
   6. Dust control must be implemented on all sites exposed to wind erosion.
   7. Keep copies of permits and inspections on Site at all times.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. Soil erosion and sedimentation control rules and guidelines of:
      a. State of Michigan R323.2190 National Permit for stormwater discharge from Construction (Michigan's "Permit by Rule").
      b. Michigan Natural Resources and Environmental Protection Act, Part 31 of Act 451 of 1994 Soil Erosion and Sedimentation Control (Water Resources Protection Act).
      c. Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act (Soil Erosion and Sedimentation Control (SESC).
      d. EGLE Nonpoint Source Best Management Practices Manual.
      e. Wayne County Stormwater Control Program, Adopted September 2021.
   2. ASTM Standards:
      a. A974 – Standard Specification for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic-Coated or Polyvinyl Chloride (PVC) Coated).
      b. C33/C33M – Standard Specification for Concrete Aggregates.
      c. D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
      d. D4751 -Standard Test Method for Determining Apparent Opening Size of a Geotextile.
      e. D4992 – Standard Practice for Evaluation of Rock to be Used for Erosion Control.
      f. D5313 – Standard Test Method for the Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions.
      g. D6092 – Standard Practice for Specifying Standard Sizes of Stone For Erosion Control.
      h. D6459 – Standard Test Method for Determination of Erosion Control Blanket (ECB) Performance in Protecting Hillslopes from Rainfall-Induced Erosion.
      i. D6461, D6462 – Standard Practice for Silt Fence Materials and Installation.
      j. D6599 – Practice for Construction of Live Fascines on Slopes.
      k. D6711 – Practice for Specifying Rock to Fill gabions, Revet Mattresses, and gabion Mattresses.

1.4 SUBMITTAL

A. Action Submittals (Manufacturers information):
   1. Mulch blankets.
   2. Geotextile fabric.
   3. Silt Fence.
   4. Inlet Protection.
   5. Seed mixtures.
   6. Tacking Agents.
   7. Fertilizer.

B. Informational Submittals:
   1. Name and certification number of certified storm water operator that will be responsible for Site inspections.
   2. Sequence of Construction in sufficient detail as requested by Engineer.

1.5 QUALITY ASSURANCE

A. Performance Standard:
   1. Compliance with the Soil Erosion Control Permit (Part 91) and the Michigan Permit by Rule. The SESC measures indicated on the Drawings and specified here in are a minimum requirement. If more SESC measures are required to comply with the permit, notify the Engineer responsible for preparation of the SESC plan for plan amendment. Additional SESC measures required due to the Contractor's operations will not be considered for additional payment.

B. SESC Preconstruction Meeting:
   1. Conduct a field evaluation of the Site with the Engineer, Certified Storm Water Operator, the Local Enforcing Agent, and the Contractor's Superintendent after all initial SESC measures are installed and prior to any clearing, grading or excavation work.
   2. This meeting shall be scheduled and organized by the Contractor.
   3. Review the installed SESC measures by walking the Site and confirm compliance to the Permit and the approved SESC Plan.
   4. Review the location for display of the permit.
   5. Review location for SESC inspection log.

C. Stop Work Order:
   1. Owner reserves the right to issue a Stop Work Order if soil erosion and sedimentation controls are not properly installed or maintained.
   2. Work performed under a Stop Work Order will not be considered for payment.
   3. Costs resulting from delay due to issuance of a Stop Work Order shall be the responsibility of Contractor.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, damage by weather or elements, and in accordance with manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 SOIL EROSION AND SEDIMENTATION CONTROL MATERIALS

A. Stabilized Construction Entrance:
   1. Stabilize a pad of clean crushed stone located at points where traffic will be accessing a construction site. Minimize construction access points to locations as indicated on the Drawings.

2. Stone Size – Use ASTM C33, size No. 2 (2-1/2-inch to 1-1/2-inch) or 3 (2 inch to 1 inch). Use clean crushed angular stone. Crushed concrete of similar size may be substituted, but will require more frequent upgrading and maintenance.
3. Place on woven geotextile fabric if underlying soils are soft. TerraTex GS, or equal.
4. Thickness: Not less than 6 inches.
5. Width: Not less than full width of points of ingress or egress or a minimum of 20 feet.
6. Length: 50 feet minimum where the soils are course grained (sands or gravels) or 100 feet minimum where soils are fine grained (clays or silts), except where the traveled length is less than 50-feet or 100 feet respectively. These lengths may be increased where field conditions dictate. Stormwater from up-slope areas shall be diverted away from the stabilized pad where the slope of the access road exceeds 5%, a stabilized base of Hot Mix Asphalt Base Course.

B. Track Out Control:
1. Mats specifically designed and manufactured for the purpose of removing sediment from construction vehicles.
2. Must meet size requirements indicated on the Drawing.
3. Approved manufacturers:
   a. FODS Trackout Control Mat 1x7T.
   b. Rumble Grate by Grizzley or ASP Enterprises.
   c. Approved equal.

C. Temporary Vegetation:

Seed Type	Lower Peninsula (south of US10)*	Lower Peninsula (north of US10)*	Upper Peninsula*	Seeding Rate
Oats, Barley	4/1 to 9/15	4/15 to 8/1	5/1 to 8/1	2 lbs/1,000 sft
Annual Rye	8/1 to 10/15	8/1 to 10/10	8/1 to 11/1	3 lbs/1,000 sft
Wheat	9/20 to 10/15	9/10 to 10/10	9/10 to 10/1	3 lbs/1,000 sft
Buckwheat	6/1 to 7/15	6/1 to 7/15	6/15 to 7/15	2 lbs/1,000 sft
Perennial Ryegrass	8/1 to 10/15	8/1 to 10/1	8/1 to 10/1	1 lbs/1,000 sft
*Seasonal Limitation Dates				

D. Permanent Vegetative Cover:
1. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application, and mulch anchoring.
2. Immediately prior to seeding and topsoil application, the subsoil shall be evaluated for compaction.
3. Topsoil should be handled only when it is dry enough to work without damaging the soil structure. A uniform application to a depth of 4 inches (unsettled) is required on all sites. Topsoil shall be amended with organic matter, as needed, in accordance with the Standard for Topsoiling.
4. See Division 32 Section “Seeding” for Seasonal requirements.

E. Mulch Blanket:
1. 4H:1V: Straw; North American Green S-75; LANDLOK S1; or equal.
2. 3H:1V: Straw; North American Green S-150; LANDLOK S2; or equal.
3. 2H;1V: Straw and Coconut: North American Green SC-150; North American Green P-300, LANDLOK SC2; or equal.
4. 1.5H:1V: Coconut: North American Green C-125; LANDLOK C2; or equal.
5. Anchoring Staples or Pins:
   a. Hardwood stakes at least 6 inches long; or
   b. North American Green Bio-Stake blanket pins at least 6 inches long; or
   c. Steel anchoring pins are not allowed without written permission of the Engineer.

F. Hydro-Mulch:
1. Biodegradable, Hydraulic Mulch (HM) composed of 100% recycled cellulose fibers and a tackifier.
2. Terra-Mulch Cellulose with Tacking Agent 3.

G. Tacking Agents:
1. Materials: Polyacrylamide, acrylamide copolymer, hydro-colloid polymers, marker dye.
2. pH Range: 7.0 ±0.2.

3. Surface Tension: 73.9 dynes/cm, based on simulated field application after 5 minutes of mechanical agitation.
4. Viscosity: 102 CPS ±2, Saybolt value, based on 30 pounds per 1,000 gallons of water and 197 CPS ±2, Saybolt value, based on 60 pounds per 1,000 gallons of water, based on simulated field application after 5 minutes of mechanical agitation.
5. University tested to reduce erosion 68.6% and reduce water runoff 21.7% on a 45% slope without having to cure (dry out), effective immediately after hydro-seeding application.
6. Terra-Mulch Tacking Agent 3 by Profile Products LLC.

H. Riprap:
1. Stone for riprap shall consist of natural field stone or crushed quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering. The specific gravity of the individual stones shall be at least 2.5.
2. Recycled rubble concrete may not be used.
3. The riprap shall be composed of a well-graded mixture such that 50% of the mixture by weight shall be larger than the d50 size as determined from the design procedure. A well-graded mixture as used herein is defined as a mixture composed primarily of the larger stone sizes, but with a sufficient mixture of other sizes to fill the progressively-smaller voids between the stones. The diameter of the largest stone size in such a mixture shall be 1.5 times the d50 size. The d75 should be 1.25 times the d50 and the d15 should be 0.5 times the d50 size.

I. Geotextile Fabric for Riprap:
1. Synthetic Industries, Terra Tex HD, or equal.
2. Woven, high strength polypropylene.
3. Grab Tensile Strength: 315 pounds (min) in accordance with ASTM D4632 (min).
4. Apparent Opening Size: 40 US sieve (max) in accordance with ASTM D4751 (max).
5. Water Flow Rate: 4 gpm/sft (min) in accordance with ASTM D4491 (min).

J. Silt Guard:
1. Above Ground Filters:
   a. Frame and Filter Assembly: Silt Saver, Inc.; or equal.
   b. Nonwoven polypropylene filter with needle punched holes.
   c. High density polyethylene frame.
   d. 60-inch frame, high flow filter.
   e. Filter Material: 120 gpm/sft (min).
   f. Apparent Opening Size (AOS): 40 US Std. Sieve.
   g. Tensile Strength (ASTM D4632): 410/300 (min).
2. Inlet Protection (Catch Basins):
   a. Siltsak; by ACF Environmental, Inlet Pro Sediment Bag High Flow; by Hanes Geo Components; DANDY BAG by Dandy Products Inc, or equal.
   b. Geotextile fabric silt sump.
   c. Grab tensile strength: 281x170 pounds in accordance with ASTM D4632 (min).
   d. 38 gallons per minute per square foot (GPM/SF), water flow rate in accordance with ASTM D4491 (min).
   e. Apparent Opening Size (AOS): 40 US Sieve.
   f. Manufactured to meet size of inlet.

K. Dewatering Filter Bags:
1. Ultratech International, Inc.: Ultra Dewatering Bag, SedCatch dewatering Bag; or equal.
2. Manufactured with pump pipe connection sized to match pump hose.
3. Nonwoven Geotextile, Needle Punched Polypropylene, 8 oz/syd (min).
4. Grab Tensile: 205 pounds in accordance with ASTM D4632 (min).
5. Flow Rate: 90 gpm/sft in accordance with ASTM D4491 (min).
6. Apparent Opening Size (AOS): 80 US Sieve.

L. Geotextile Silt Fence:
1. Synthetic Industries, Terra Tex SF-90, or equal.
2. Woven, high strength polypropylene.
3. Grab Tensile Strength: 100/100 lbs (min) in accordance with ASTM D4632 (min).

4. Apparent Opening Size (AOS): 20-50 US sieve (max) in accordance with ASTM D4751 (max).
5. Water Flow Rate: 8 gpm/sft (min) in accordance with ASTM D4491 (min).
6. Wood Stakes, Hardwood: 1.5-inch x 1.5-inch x 48-inch (min), 6 foot spacing (max) with 3/8-inch thick lath fastening bar.

M. Wire Reinforced Geotextile Silt Fence:
1. Steel fence posts, 5 foot spacing (max).
2. Wire Mesh 6-inch x 6-inch x 14.5 gage (min).

N. Check Dams:
1. Washed Crushed Stone.
2. Size: 2-inch minimum, 4-inch maximum.

O. Sediment Logs:
1. Curlex Sediment Logs by American Excelsior Co, SEDIMAX-SW; or equal.
2. 12-inch sediment log diameter, 10 or 25 foot length.
3. 40 GPM/sft in accordance with ASTM D5141.
4. Inner Core: Great Lakes Aspen excelsior with interlocking barbs.

P. Filtration Logs:
1. SEDIMAX-FR by Tensar; or equal.
2. 9-inch log Diameter, 50 foot length.
3. Inner core: 70% straw (1.2lbs/syd), 30% coconut (0.5 lbs/syd) fiber matrix.
4. Netting must be constructed from 100% biodegradable woven natural organic fiber netting.

Q. Sediment Basin Outlet Barrier:
1. Natural Rock:
   a. Sound, tough, durable rock.
   b. Graded with a nominal diameter of 6 inches.

PART 3 - EXECUTION

3.1 GENERAL

A. Standards:
1. Achieve Effective Erosion Control to prevent erosion of Site slopes and ditches.
2. Achieve effective control of sedimentation to prevent any offsite discharge or tracking of Site soils.
3. Maintain soil erosion and sedimentation controls until the Site is stable. Definition of stable site is final concrete and/or asphalt paving is complete, and all turf areas have 80% growth.
4. Do not remove temporary soil erosion and sedimentation control measures until Site is determined to be stable by the Engineer.
5. Sweep streets weekly, or more frequently if required, or directed by Engineer.

3.2 DUST CONTROL

A. Prevent blowing and movement of dust from exposed soil surfaces, prevent on Site and off Site damage and health hazards and improve traffic safety:
1. The following methods should be considered for controlling dust.
   a. Mulches.
   b. Temporary Vegetative Cover.
   c. Spray-on Adhesives: Keep traffic off these areas.

3.3 CONSTRUCTION ENTRANCE DRIVE

A. Employ water truck and street sweeper as necessary to keep sediment off of on Site and off Site roadways. The entrance must be maintained in a condition which will prevent tracking or flowing of sediment onto roadways. This may require periodic top dressing with additional stone or additional length as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto roadways (public or private) or other impervious surfaces must be removed immediately.

B. Where accumulation of sediment is inadequately cleaned or removed by conventional methods, a power broom or street sweeper will be required to clean paved or impervious surfaces. All other access points which are not stabilized must be blocked off.

3.4 INLET PROTECTION

A. Install on existing inlets prior to any grading or excavation. Install on new inlets as soon after installation as practical.

B. Inspect frequently, especially after any rain event. Maintain repair, and replace promptly, as needed.

C. Remove barrier only when the area draining toward the inlet has been stabilized.

3.5 SOIL ROUGHENING

A. On all slopes 1:3 or steeper, grade the slope with a dozer taking a vertical path so that the track marks on the slope create a horizontal roughened grooved condition to help prevent erosion of the slope.

3.6 TEMPORARY VEGETATIVE COVER

A. General:
   1. Provide temporary seed if permanent measures will not be placed within 15 days of initial disturbance and area will not undergo further earth change within 15 days of initial disturbance.
   2. Seed: Apply uniformly at a minimum rate of 3 to 5 pounds per 1,000 square feet.
   3. Mulch:
      a. Mulching is required on all seeding. Mulch will protect against erosion before grass is established and will promote faster and earlier establishment. The existence of vegetation sufficient to control soil erosion must be deemed compliance with this mulching requirement.
      b. Straw: Unrotted small grain straw, free of seeds
      c. Application: Spread mulch uniformly by hand or mechanically so that at least 85% of the soil surface is covered. For uniform distribution of hand-spread mulch 75 to 100 pounds per 1,000 square feet. Anchoring must be accomplished immediately after placement to minimize loss by wind or water. This may be done by one of the following methods, depending upon the size of the area, steepness of slopes.
         1) Peg and Twine. Drive 8 to 10 inch wooden pegs to within 2 to 3 inches of the soil surface every 4 feet in all directions. Stakes may be driven before or after applying mulch. Secure mulch to soil surface by stretching twine between pegs in a crisscross and a square pattern. Secure twine around each peg with two or more round turns.
         2) Mulch Nettings: Staple paper, jute, cotton, or plastic nettings to the soil surface. Use a degradable netting in areas to be mowed.
         3) Crimper (mulch anchoring coulter tool): A tractor-drawn implement, somewhat like a disc harrow, especially designed to push or cut some of the broadcast long fiber mulch 3 to 4 inches into the soil so as to anchor it and leave part standing upright. Straw mulch rate must be 3 tons per acre. No tackifying or adhesive agent is required.

4) Liquid Mulch-Binders (May be used to anchor straw mulch):
   a) Applications should be heavier at edges where wind may catch the mulch, in valleys, and at crests of banks. The remainder of the area should be uniform in appearance.
   b) Wood-fiber or paper-fiber mulch: must be made from wood, plant fibers or paper containing no growth or germination inhibiting materials, used at the rate of 1,500 pounds per acre (or as recommended by the product manufacturer) and may be applied by a hydroseeder. Mulch must not be mixed in the tank with seed. Use on flatter slopes and during optimum seeding periods in spring and fall.

3.7 PERMANENT VEGETATIVE COVER

A. General:
   1. Seed all disturbed areas within 5 days of final grading.
   2. Apply uniformly at a minimum rate of 3 to 5 pounds per 1,000 square feet.
   3. Mulch as indicated on the Drawings or as needed to effectively control soil erosion.

3.8 MULCH BLANKET

A. Direction of installation, staple patterns and other requirements in accordance with Manufacturer's directions, and Project Drawing detail sheets.

B. Location: Where indicated on the Drawings or as specified.

3.9 HYDRO MULCH

A. Apply in accordance with manufacturer, Application Rate: 2,000 pounds per acre.

3.10 TACKING AGENTS

A. Fiber Mulch Binding:
   1. Flat to 5:1 Slope: 20 pounds per acre.
      a. 4:1 to 3:1 Slope: 30 pounds per acre.
      b. 3:1 to 2:1 Slope: 40 pounds per acre.
      c. Greater than 2:1 Slope: 60 pounds per acre.
   2. Straw Mulch Binding: 30 pounds Tacking Agent III and 150 pounds cellulose fiber per 1,000 gallons of water per acre, or 50 pounds Tacking Agent III per 1,000 gallons of water per acre.

3.11 GEOTEXTILE SILT FENCE

A. Space posts 6 feet center-to-center or closer. Extend at least -12-inches into the ground. Posts shall be constructed of hardwood with a minimum diameter thickness of 1-1/2 inches.

B. Wire Backed silt fence: A metal fence with 6 inch or smaller wire mesh openings and at least 2 feet high may be utilized, fastened to the fence posts, to provide reinforcement and support to the geotextile fabric. Place posts 6 feet on center.

C. Bury geotextile fabric at least 6 inches deep in the ground. Extend The fabric at least 2 feet above the ground. The fabric must be securely fastened to the posts using a system consisting of metal fasteners (nails or staples) and a high strength reinforcement material (nylon webbing, grommets, washers, etc.) placed between the fastener and the geotextile fabric. The fastening system must resist tearing away from the post. Install silt fence in accordance with manufacturer's instructions, and Project Drawing detail sheets.

D. Location: Where indicated on the Drawings or as needed to prevent offsite movement of soil.

3.12 FIBER ROLLS

A. Vertical spacing on slopes:
   1. As indicated on the Drawings, or
   2. 1:1 slopes: 10 feet apart.
   3. 2:1 slopes: 20 feet apart.
   4. 3:1 slopes: 30 feet apart.
   5. 4:1: slopes: 40 feet apart.

3.13 RIPRAP

A. Place no bends or curves at the intersection of the conduit and apron or scour hole will be permitted.

B. There must be no over fall from the end of the apron to the receiving channel.

3.14 DEWATERING

A. If during construction excavated facilities need to be dewatered to facilitate or complete the construction process and the water pumped out of the excavated areas contain sediments, these sediments must be removed prior to discharging to receiving bodies of water. This standard does not address the removal of ground water through well points etc.

B. Pumping system must include adequate sized perforated riser pipes, stone filters and sediment pumping bags to achieve desired results. Place the suction hose from the pump inside the inner pipe to begin dewatering. Place the discharge hose in a stabilized area downslope of unstabilized areas to prevent erosion.

C. Sediment Tank / Silt Control Bags may be used when sediment laden water is pumped to trap and retain the sediment. A sediment tank or a silt control bag is to be used when excavations are deep, and space is limited and where direct discharge of sediment laden water to stream and storm drainage systems is to be avoided.
   1. Locate containers (tanks or bags) for ease of clean-out and disposal of the trapped sediment and to minimize interference with construction activities and pedestrian traffic. Do not place bags directly into receiving waters.
   2. Tank size: The following formula should be used in determining the storage volume of the tank: 1 cubic foot of storage for each gallon per minute of pump discharge capacity. Typical tank configuration is indicated on Standard Detail. Tanks may be connected in series to increase effectiveness.

3.15 SEDIMENT BASIN

A. Size and location as indicated on the Drawings. Sediment basins, not indicated on the Drawings but required due to Contractor's means, methods or convenience, will be considered incidental work.

B. Maintenance:
   1. Remove sediment when sump basin is 50% full.
   2. Remove sediment prior to final completion.
   3. Remove outlet barrier when soil disturbed by the work has stabilized.

3.16 VEGETATED SPILLWAY SIDE INLET

A. General: Conform to slopes and dimensions indicated on the Drawings.

B. Grading:
   1. Excavate to finished grade of required section and slope.
   2. Dig trenches on upstream and downstream toe.
   3. Hand rake grade to prepare seed bed.
   4. Remove rocks, clods, and clumps larger than 1/2-inch diameter.

C. Fertilizer: Spread fertilizer at a rate of 2 pounds per 100 square foot and rake into seed bed.

D. Geotextile Fabric:
   1. Place geotextile fabric in bottom of prepared side inlet.
   2. Extend geotextile fabric into trenches for anchorage at upstream and downstream.
   3. Staple geotextile fabric at 1-foot to 2-foot intervals.

E. Seeding: Spread seed at a rate of 2 pounds per 100 square feet.

F. Placing Mulch Blanket:
   1. Place mulch blanket over seed and extend ends into both trenches.
   2. Fill upstream trench with earth and downstream trench with plain riprap.
   3. Ensure continuous contact between mulch blanket and soil.
   4. When required, overlap adjacent rolls of mulch blanket a minimum of 18 inches.
   5. Staple mulch blanket at 2-foot intervals. Place additional staples as necessary.

G. Maintenance: Regrade, relay riprap, geotextile fabric, and mulch blanket, reseed and refertilize as necessary to establish a uniform and stable grassed area.

3.17 TILE DRAIN OUTLETS

A. Installation:
   1. In accordance with Division 31 Section "Excavation and Fill for Utilities" and Division 33 Section "Storm Drainage Utilities."
   2. Backfill with suitable material.
   3. Minimum pipe slope: 0.10%.
   4. Extend to prevent erosion of the channel bank.
   5. Joints:
      a. Like Materials: Manufactured connector.
      b. Unlike Materials: Wrap with geotextile fabric and pour concrete collar to form a soil tight joint.
   6. Outlet Protection: Splash pad in accordance with Division 31 Section "Riprap."

3.18 BUILDING PROJECT CONSTRUCTION

A. During construction conform to the following general rules:
   1. Minimize the amount of earth disturbed at any one time.
   2. Establish a construction sequence which includes adequate erosion control.
   3. As much as practical, direct stormwater away from the construction area. Direct diverted stormwater to a stable on-Site area.
   4. Collect runoff from the Site in sediment basins, traps or through filters.
   5. Establish an inspection and maintenance schedule, paying special attention to the beginning of the various stages of construction.

3.19 OPEN CHANNEL EXCAVATION

A. Power equipment such as bulldozers shall not enter the water unless approved by Engineer.

B. Complete excavation, clearing, grubbing, snagging, tree cutting, pulling, raking, and related work in such a way as to minimize erosion of soil in the areas in which work is completed.

C. Construct sediment basins prior to excavation.

D. Comply with measures for soil erosion and sediment control as indicated on the Drawings.

3.20 AIRBORNE SEDIMENT

A. Dust Control:
   1. Use legal means necessary to control dust on and near the Work and on and near off Site borrow areas if such dust is caused by Contractor's operations during performance of the Work or if resulting from the condition of the Site when earthwork operations are suspended.

2. Treat haul roads, delivery roads, temporary Site access roads and other surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the Site, and as directed by Engineer.
3. Periodically scrape and broom adjacent streets and paved areas to remove tracked dirt.

B. Wind Erosion:
1. Erect and maintain barriers to prevent migration of windblown sediment offsite.
2. Conduct operations in such a manner as to minimize the amount of Site area exposed to wind erosion.
3. Be responsible for removal of windblown sediments deposited off Site, including costs for cleaning or repairs required due to sediment deposition and removal.

END OF SECTION 31 25 00

SECTION 31 37 00 – RIPRAP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the major items listed below:
   1. Preparation of subgrade.
   2. Geotextile liner.
   3. Riprap.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standards/Test Methods:
      a. ASTM D3786 – Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method.
      b. ASTM D4491 – Water Permeability of Geotextiles by Permittivity.
      c. ASTM D4533 – Trapezoid Tearing Strength of Geotextiles.
      d. ASTM D4632 – Grab Breaking Load and Elongation of Geotextiles.
      e. ASTM D4751 – Determining Apparent Opening Size of a Geotextile.
      f. ASTM D4833 – Index Puncture Resistance of Geomembranes and Related Products.
      g. ASTM D5199 – Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
      h. ASTM D5261 – Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
   2. AASHTO: M288 – Geotextiles Used for Subsurface Drainage Purposes.
   3. State DOT Current Standards:
      a. Specifications for Construction.
      b. Standard Plans.

1.4 DELIVERY, STORAGE AND HANDLING

A. Geotextile liner shall be delivered in original, unbroken, brand-marked wrapping indicating Manufacturer's name and Product description.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.5 SUBMITTALS

A. Action Submittals:
   1. Product Data for Each of the Following:
      a. Geotextile liner.
      b. Riprap source and gradation.
      c. Grout.
   2. Shop Drawings for Precast Concrete Blocks:
      a. Dimensions.
      b. Details of construction and installation.
      c. Concrete used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Geotextile Liner:
1. Type: Nonwoven.
2. Physical Requirements Schedule:

	Heavy Riprap	Plain Riprap
Grab Tensile Strength (Min.), lbs. ASTM D 4632	270	200
Trapezoid Tear Strength (Min.), lbs. ASTM D 4533	100	75
Puncture Strength (Min.), lbs. ASTM D 4833	100	75
Mullen Burst Strength (Min.), lbs. ASTM D 3786	400	200
Permittivity Per Second, Sec. ASTM D 4491	0.5	0.5
Apparent Opening Size (Max.), mm ASTM D 4751	0.21	0.21
In accordance with MDOT Table 910-1		

3. Manufacturers:
   a. Propex, Geotex.
   b. TenCate, Mirafi.
   c. Or equal.

B. Riprap:
1. Rock: Naturally occurring, sound, tough and durable rock including fieldstone, limestone or other quarry rock. Not containing soil.
2. Broken Concrete: Sound pieces free from structural defects. Not containing soil, HMA or protruding reinforcing steel.
3. “Footprint” Dimension of Each Piece:
   a. Plain Riprap: 8 inches minimum to 16 inches.
   b. Heavy Riprap: 16 inches minimum, with a maximum to minimum dimension ratio no greater than 3 to 1.
4. Thickness Dimension of Each Piece:
   a. Plain Riprap: 8 inches minimum.
   b. Heavy Riprap: 8 inches minimum.
5. Smaller pieces may be used for filling spaces between rocks.
6. Precast Concrete Blocks:
   a. Concrete: MDOT Grade P2.
   b. Surface Area:
      1) Maximum:
         a) Plain Riprap: 15 square feet.
         b) Heavy Riprap: 20 square feet.
      2) Randomly scored with plane of weakness joints into sections of:
         a) Minimum Area: 4 square feet.
         b) Maximum Area: 9 square feet.
   c. Minimum Dimension (Thickness):
      1) Plain Riprap: 6 inches.
      2) Heavy Riprap: 16 inches.
   d. Lifting lugs, cast into concrete blocks, shall not project above the finished surface.

PART 3 - EXECUTION

3.1 PREPARATION

A. Grading:
1. Excavate or fill to the required subgrade and dispose of surplus excavated material in accordance with Division 31 Section “Grading.”
2. Slope bank to a minimum slope of 1-1/2 horizontal to 1 vertical.
3. Compact subsurface to 90% of Maximum Unit Weight.
4. Tolerance: +0.2 feet from plan grade.

3.2 INSTALLATION

A. Geotextile Liner:
   1. Required where indicated on Drawings only.
   2. Place geotextile prior to riprap and secure against movement during placement of riprap.
   3. Place geotextile in a key trench at the toe of the slope if the riprap ends at or below a high water elevation. Construct the key trench to 1-1/2 feet deep and wide, or three times the minimum riprap dimension, whichever is greater. Backfill trench with riprap.
   4. Place riprap onto geotextile without dumping or dropping riprap into place.
   5. After riprap is in place, anchor geotextile in a key trench at the tops of slopes 3 horizontal to 1 vertical or steeper. Backfill trench with soil or riprap.
   6. Overlap At Seams: 2 feet minimum, with overlap in the direction of flow.
   7. Follow Manufacturer's installation guidelines.

B. Riprap:
   1. Thickness of Treatment:
      a. Riprap: 8 inches minimum.
      b. Heavy Riprap: 16 inches minimum.
      c. Concrete blocks: In accordance with dimensions in Paragraph 2.1.
   2. Rock:
      a. Place beginning in the trench at the toe of slope and progress up slope.
      b. Place individual stones, embedding each stone into the slope, and interlock against adjoining stones.
      c. Compact as construction progresses.
      d. Fill voids with smaller pieces, as approved by Engineer.
      e. Measured perpendicular to the slope.
   3. Broken Concrete:
      a. Place instead of rock with Engineer's approval only.
      b. Place with minimum thickness perpendicular to slope.
      c. Place beginning at toe of slope and progress up slope.
      d. Place to present an even, tight surface.
      e. Place heavy riprap in 2 layers with staggered joints.
      f. Fill all voids as required by Engineer.
   4. Precast Concrete Blocks:
      a. Placed instead of rock with Engineer's approval only.
      b. Place with minimum thickness perpendicular to slope.
      c. Place beginning at toe of slope and progress up slope.

3.3 MAINTENANCE

A. Replace dislodged or missing riprap and restore torn or dislocated geotextile liner to maintain a uniform riprapped area until final completion.

END OF SECTION 31 37 00

SECTION 31 62 16 – STEEL PILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of rolled steel section piles and related accessories.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standards:
      a. A6 – Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.
      b. A36 – Specification for Structural Steel.
      c. A123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      d. A148 – Steel Castings, High Strength, for Structural Purposes.
      e. A572 – Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.
      f. A673 – Specification for Sampling Procedure for Impact Testing of Structural Steel.
      g. A780 – Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      h. D1143 – Test Methods for Deep Foundations Under Static Axial Compressive Load.
      i. D3689 – Test Methods for Deep Foundations Under Static Axial Tensile Load.
      j. D3966 – Test Methods for Deep Foundations Under Lateral Load.
      k. D4945 – Test Methods for High-Strain Dynamic Testing of Piles.
   2. American Welding Society: D1.1 – Structural Welding Code – Steel.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Protect and be responsible for damage caused by pile-driving activities to adjacent structures and properties.

1.5 SUBMITTALS

A. Shop Drawings to include the following:
   1. Details and schedule of pile installation.
   2. Pile lengths, size and strength to suit design loads.
   3. Details of pile points and splices.

B. Material Certification: Submit mill test reports for steel materials.

C. Driving Equipment Information:
   1. Hammer type to be used.
   2. Formula or Graph: Required number of hammer blows to achieve a pile capacity as indicated on the Drawings.
   3. Provide wave equation analysis verifying proper size of pile hammer for existing conditions and materials.
   4. Provide information on the type of pile cushion used.

D. Project Record Documents:
   1. Maintain accurate records of the following for piles driven:
      a. Sizes, lengths and locations of piles.
      b. Sequences of driving.
      c. Number of blows per foot for entire length of piles and set for last 10 blows.
      d. Final tip and head elevations.
      e. Driving force of each hammer blow.
   2. Submit 2 copies of Project record documents to Engineer under provisions of Division 01 Section "Submittal Procedures."

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.
   3. Show experience in completed projects of similar size with piles of similar size and length and driven in similar material.

B. Test Piles: Verify pile capacities during installation using an approved dynamic pile driving equation or by other methods. Provide copy of report to Engineer.

C. Inspection: All pile driving activities shall be inspected and documented by an independent testing laboratory in accordance with Division 01 Section "Special Inspections and Tests."

D. Welder's Qualifications:
   1. The specification for each welding procedure shall be qualified in accordance with the rules in ASME Boiler and Pressure Vessel code.
   2. Welder shall be qualified by tests in accordance with AWS D1.1.
   3. Welder's qualification papers shall be required from an independent testing laboratory. Welder's last qualification shall be within 1 year from the beginning of construction.
   4. Engineer, at Engineer's discretion, may accept evidence of previous qualifications.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protection of Piles: Prevent surface damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rolled Steel Section Piles:
   1. Material: ASTM A252, Grade 3.
   2. Size: 10-inch nominal, 10-3/4-inch outside diameter, 0.188-inch wall thickness.
   3. Splices: Full penetration butt welds.
   4. Galvanized: In accordance with ASTM A123.

B. Welding: Electrodes: AWS E 60 or E 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cribbing and other material to support the driving equipment.

B. Pile Head Protection:
   1. Use cushion cap.
   2. Ensure full bearing on piles for proper distribution of hammer blow.
   3. Do not damage piles during driving operations.

C. Alignment:
   1. Hold piles securely and accurately in position while driving.
   2. Deliver hammer blows in direct axis of the piles.

D. Pile Driving Limits:
   1. To the required bearing capacity.
   2. If less than or more than the specified length:
      a. To recognized refusal by testing agency and Engineer.
      b. To required pile load capacity.
   3. Minimum bearing elevation 630.

E. Locate Piles:
   1. As indicated on the Drawings or as otherwise directed by Engineer.
   2. Pile Centers: To an accuracy of +3 inches.

F. Unusual Soil Conditions: Discontinue driving operations and notify Engineer if conditions are encountered such that pile load capabilities are not being obtained by refusal.

G. Field Cuts:
   1. After completed pile installation, cut off top of piles to elevations indicated.
   2. Coat the cut off pile top in accordance with ASTM A780.

H. Obstruction, Cut-Off Pile and Adjacent Pile:
   1. If an obstruction, including, but not limited to, boulders and timbers, prevents placing the pile to the depth required or causes the pile to drift from the required location, then:
      a. Cut off top of pile at elevation determined by Engineer, and
      b. Drive adjacent full-length pile as approved by Engineer.
   2. Payment will be made at the Contract unit price for any approved additional pile lengths driven.
   3. Apply best possible means and equipment if obstructions are encountered at no additional cost to Owner. If obstruction continues to impede driving the pile, move on to other piles to minimize standby time.

I. Pile Splices:
   1. Damaged top of driven pile shall be cut off prior to splicing.
   2. Shore and brace piles prior to splicing.
   3. Coat the splice in accordance with ASTM A780 and Division 09.

J. Cap Plates: Weld pile cap plates to piles as indicated.

K. Backfill subsidence of grade due to pile during activity in accordance with Division 31 Section “Excavation and Fill for Structures.”

3.2 CLEANING

A. General: Clean all installed materials and related areas in accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 31 62 16

SECTION 31 66 26 – HELICAL FOUNDATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes design and construction of a helical foundation system.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. A36 – Carbon Structural Steel.
      b. A123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      c. A780 – Standard Practice for Repair of Damaged and Uncoated Hot-Dip Galvanized Coatings.
      d. D1143 – Test Method for Piles Under Static Axial Compressive Load.
   2. AWS – American Welding Society publications:
      a. ANSI/AWS D1.1 – Structural Welding Code – Steel.

1.4 SYSTEM DESCRIPTION

A. Description:
   1. The system consists of helical anchors for the support of new underpinning and for new construction as indicated on the Drawings.
   2. The Contract Documents are intended to indicate the general concept and approximate locations of the helical foundation system and shall not relieve the Contractor from design or construction liability.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

A. Professional Engineering: Retain the services of a professional engineer licensed in the State of Michigan, experienced in geotechnical engineering and in helical foundation system design, who shall design the helical foundation system.

B. Design:
   1. Loads to which the helical foundation system will be subjected are indicated on the Drawings.
   2. Select anchor size, depth, quantity and locations to carry indicated loads with a maximum total settlement of 1/2-inch and a maximum differential settlement of 1/4-inch.
   3. Design brackets, slab plates, anchor bolts and accessories to carry the indicated loads with a minimum factor of safety of 2 (4 for grouted or expansion anchor bolts).

C. Quantities: Determine the required helical foundation system and use as the basis for a lump sum bid.

1.6 SUBMITTALS

A. Shop Drawings: For entire helical foundation system:
   1. Required Information:
      a. Helical foundation layout.
      b. Individual design capacities.
      c. Expected depth to reach design capacities.
      d. Connection details of anchors to walls and slabs.
      e. Foundation bracket anchor bolt's capacities.

2. Obtain Engineer's review before proceeding with ordering or fabrication of items of this Section.
3. Submit Shop Drawings sealed by engineer responsible for the helical foundation system design, as engaged by Contractor.

B. Torque Calibration: For installation equipment to be utilized for this project:
1. Required Information:
a. Type of torque indicator.
b. Date of calibration.
c. Calibration curves, if applicable.

C. Installation Records: For each anchor driven for the project:
1. Required Information:
a. Project name.
b. Contractor's name.
c. Date and time of installation.
d. Location of anchor.
e. Elevation of anchor lead and lengths of lead sections.
f. Size of anchor.
g. Installation torque at 1-foot intervals.
h. Unusual or unexpected conditions encountered.

1.7 QUALITY ASSURANCE

A. Qualifications: Installer for work of this Section shall have not less than 5 years of field experience in helical foundation system installations.

B. Inspection of Helical Foundation System: In accordance with Division 01 Section "Special Inspections and Tests."

C. Load Tests: Provide load testing in accordance with Part 3 of this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with these requirements, provide products by one of the following:
1. A.B. Chance Company.
2. Atlas Systems, Inc.

2.2 MATERIALS

A. General:
1. Materials used for Project shall be standard products of Manufacturer as selected by helical foundation system designer.
2. Foundation Brackets:
a. Weldable steel plate, ASTM A36; or equal.
b. Welds: In accordance with AWS D1.1.
3. Anchor Bolts for Foundation Brackets:
a. Commercially available drilled – in expansion bolts or grouted rods.
b. Products whose Manufacturer has capacity data certified by independent testing laboratory.
4. All components shall be hot dipped galvanized after fabrication in accordance with ASTM A123.

PART 3 - EXECUTION

3.1 PREPARATION

A. Equipment Selection: Contractor shall be responsible for selection of equipment necessary to produce the design helical foundation system in the conditions present at the Project Site.

B. Control Points:
   1. Prior to installation of helical foundation system under existing construction, establish a system of control points on the existing adjacent structures. Submit plan of this system to Engineer for review.
   2. Maintain the control points prior to anchor installation and regularly thereafter submit reports to Engineer.
   3. Report all detected settlement, horizontal movement, or damage to the structures being monitored immediately to Contractor's professional engineer and Engineer.
   4. If, in the opinion of the Contractor's professional engineer, or Engineer, or both, the movements of structures being underpinned are judged to possibly endanger the stability of the structure being underpinned, take immediate remedial measures sufficient to prevent further movement at no extra cost to Owner.
   5. Engineer or Contractor's professional engineer may require that other Work in the area be stopped until remedial measures have been taken to halt the progression of damage, at no extra cost to Owner.

3.2 INSTALLATION

A. Install helical foundation system in accordance with:
   1. Shop Drawings reviewed by Engineer.
   2. Manufacturer's recommendations.
   3. System designer's requirements.

B. Install helical anchors until required torque has been reached. Final installation elevation is anticipated to be approximately 641 feet but may vary based on actual subsurface conditions.

C. , which is anticipated to be at a depth of approximately 641 feet.

D. If obstructions are reached, withdraw helical anchor or abandon in place at no extra cost to Owner, and install anchor in revised location as directed by designer.

E. Maintain installation record documents and submit as specified.

F. Compress anchors supporting existing construction an amount equal to design dead load and hold that load until the anchor's foundation bracket is fully installed. Carefully transfer load from the jack to the foundation structure.

3.3 FIELD QUALITY CONTROL

A. Load Testing:
   1. Perform load testing in accordance with ASTM D1143 on 1 helical anchor, loading anchor to 200% of its design capacity.
   2. With approval of Engineer, dead weight of building components may be used as resisting the jacking force.
   3. Provide all required test equipment. Jacking forces shall be concentric with anchor.
   4. Load test may be used to generate precompression dead load required on anchor under existing construction.
   5. Submit load test data in accordance with ASTM D1143 prior to completion of the work of this Section.
   6. If load tested anchor does not meet load test criteria, reinstall until criteria is met.
   7. After load test, if load tested anchor has a significantly different depth, torque, or design to achieve its capacity than other anchors, reinstall other anchors to substantially match depth, torque and design of load tested anchor at no extra cost to Owner.

3.4 CLEANING

A. Clean materials installed under this Section in accordance with Division 01 Section "Cleaning and Waste Management."

END OF SECTION 31 66 26

SECTION 320536 - LANDSCAPE MAINTENANCE AND WARRANTY STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of landscape maintenance areas are shown on drawings and by provisions of this section.

B. Types of work required include the following:

1. Plant maintenance
2. Lawn maintenance
3. Irrigation system operation
4. Replacements
5. Warranty

C. Related Work Specified Elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 ACCEPTANCE OF INSTALLATION:

A. At the completion of all landscape installation, or pre-approved portions thereof, the Landscape Contractor shall request in writing an inspection for acceptance of installation in which the Landscape Contractor, Owner’s Representative and Landscape Architect shall be present. After this inspection a "Punch List" will be issued by the Owner’s Representative and Landscape Architect. After completion of punch list items, the Owner's Representative, Landscape Architect, and Contractor and shall re-inspect the project and upon satisfactory completion of punch list items, issue a written statement of acceptance of installation and establish the beginning of the project warranty period.

B. It is the responsibility of the Landscape Contractor to make the above written request for inspection of installation in a timely fashion. If there is plant material loss prior to acceptance of installation, the Landscape Contractor shall make all replacements of this dead material at no additional cost. These replacements are not considered to be the required one (1) replacement of dead plant material by the Landscape Contractor during the one (1) year project warranty period, as outlined below.

C. Landscape work may be inspected for acceptance in parts agreeable to Owner’s Representative and Landscape Architect provided work offered for inspection is complete, including maintenance as required.

D. For work to be inspected for partial acceptance, supply a written statement requesting acceptance of this work completed to date.

E. To ensure warranty standards, the following maintenance procedures shall be executed during construction and for the full project warranty period.

F. The standard project warranty period for all plant material including seeded and sodded lawn shall be one (1) full year from the date of acceptance.

1.4 QUALITY ASSURANCE:

A. The Landscape Contractor shall warranty all plants and lawn areas through construction and for a period of one year after date of acceptance of installation against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond the Landscape Contractor's control.

B. The Landscape Contractor shall warranty plants due to over watering or under watering during the maintenance and warranty period.

1.5 PROJECT CONDITIONS

A. The project maintenance and warranty period begins upon written acceptance of the project installation by Owner’s Representative and Landscape Architect.

B. The Landscape Contractor accepts responsibility for the irrigation system operation (if provided), watering schedule, watering amounts and monitoring system for duration of maintenance and warranty period.

C. Landscape Contractor shall be responsible for only one (1) replacement of any plant materials after project acceptance date, see Section 1.3, that are dead or in the opinion of the Owner’s Representative and Landscape Architect are in an unhealthy or unsightly condition, or having lost natural shape, resulting from die back, excessive pruning, excessive or deficient watering practices, or inadequate or improper maintenance as part of the warranty. Prior to any replacements Landscape Contractor shall review individual plants in question with Owner’s Representative and Landscape Architect and determine the reason for plant demise.

D. Replacements must meet specifications i.e. quality, species of plant material and planting procedures to receive approval of replacement materials by Owner’s Representative and Landscape Architect.

E. Costs for replacements are assumed part of bid quotations and therefore will not result in an additional cost to Owner.

F. Areas damaged as result of replacement operations are to be restored by the Contractor at no cost to the Owner.

PART 2 - PRODUCTS

A. All products as noted within applicable specification sections.

PART 3 - EXECUTION:

3.1 MAINTENANCE OF PLANTS:

A. The Contractor shall be responsible for keeping guy wires taut, plants straight and plumb, raise tree balls which settle, furnish and apply fertilizer and sprays as necessary to keep the plantings growing vigorously and free of disease and insects until the end of the warranty period. All

evergreens shall be watered thoroughly and wilt proofed in the fall to insure they do not go into the winter dry.

B. Keep planting beds free of weeds during warranty period. All portions of weed plants shall be removed including roots. Removal can be done by physical removal and/or supplemental by use of herbicides.

C. Winter Evergreen Protection:

1. Winter evergreen protection for trees and shrubs shall be provided by the Contractor during each winter season which occurs during the warranty period.
2. Prior to winter freeze conditions, the Contractor shall check root ball moisture level for all evergreen plantings and water in all plantings as required to provide optimum moisture level.
3. Supplement mulch as necessary to provide 3” depth mulch in tree and shrub beds and 2” in perennial and groundcover beds
4. Apply wilt-proof in December when temperatures are above freezing per manufacturer’s instructions. Only apply a ½ solution to Arborvitae plants.
5. At the end of November install treated (green) burlap mounted to 2” x 2” wood stakes at +/- 4’-0” oc with wood lath and roofing nails. Burlap height to be 6” above top of foliage, pulled taut, and be continuous to the ground without gaps. Note: Burlap may be folded in half to provide a double thickness for low hedges as approved by Landscape Architect.
6. Under no conditions should the treated burlap make contact with the evergreen plant material. The burlap should be stood off of the plant material 4”-6”.
7. Contractor to remove burlap and stakes in early spring when winter conditions have ceased, but no later than April 15th and provide stakes and burlap to Owner.

D. Winter Sun Scald Protection: Provide protection for all thin skinned trees (Beech, Maple, Willow, Linden, Dogwood, Honeylocust) for the first year following planting as follows: In late fall wrap trunk with light colored commercial grade tree wrap. Remove wrap in early spring once freezing conditions have ended.

E. The Contractor shall be responsible for watering of all plantings and lawn areas throughout construction, maintenance and warranty periods. The Contractor will be responsible for irrigation system operation (if available), watering schedules, watering amounts and general monitoring of irrigation system throughout the maintenance and warranty period. Overwatering or lack of from irrigation system source is the responsibility of the Landscape Contractor. Plant material and lawn area loss due to over or under watering shall be replaced in like kind by the contractor at no additional expense.

F. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition. Remove rejected plants and materials promptly. Make replacements following normal planting schedule. Replace trees and shrubs which are in doubt, unless, in opinion of Owner’s Representative and Landscape Architect it is advisable to extend warranty period for a full-growing season. Remove all stakes, guy wires, tree wrap paper, dead twigs and branches from tree and plant materials at the end of this warranty period.

3.2 MAINTENANCE OF SEEDED LAWN AREAS:

A. After acceptance of installation, and for the duration of the project maintenance and warranty period the Landscape Contractor shall continue all other maintenance procedures including fertilizing and weeding, and other operations such as rolling, regrading, replanting, and applying herbicides, fungicides, insecticides as required to establish a smooth, acceptable lawn free of eroded or bare areas.

B. Watering: See Section 3.1.F

C. At conclusion of project warranty period and after receiving written final acceptance by Owner's Representative and Landscape Architect, the Owner shall assume all seeded lawn maintenance responsibilities.

3.3 MAINTENANCE OF SODDED LAWN AREAS:

A. After acceptance of installation, and for the duration of the project warranty period the Landscape Contractor shall continue all maintenance procedures including fertilizing, weeding, rolling, regrading, re-sodding and applying herbicides, fungicides, insecticides as required to establish a smooth acceptable lawn, free of eroded or bare areas. The Landscape Contractor is not responsible for mowing after acceptance of installation.

B. See Section 3.1.F

C. At conclusion of project warranty period and after receiving written final acceptance by Owner's Representative and Landscape Architect, the Owner shall assume all sodded lawn maintenance responsibilities.

D. Unless specifically noted in the contract, mowing of seeded lawn areas shall be the Contractor's responsibility until acceptance of installation.

3.4 FINAL ACCEPTANCE:

A. At the conclusion of the project warranty period the Landscape Contractor shall request a project inspection for final acceptance in which the Owner's Representative, Landscape Architect, and Landscape Contractor shall be present. After this inspection a "Warranty Walk Punch List" will be issued. Upon completion of all punch list items, the Owner's Representative and Landscape Architect shall reinspect the project and issue a written statement of final acceptance. Upon final acceptance the Owner assumes all maintenance responsibilities for the landscape of the project.

PART 4 - PRODUCTS - Not Applicable

PART 5 - EXECUTION - Not Applicable

END OF SECTION 320536

SECTION 32 11 23 – AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes furnishing and installation of the major items listed below:
   1. Base course.
   2. Subbase.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with the following:
   1. ASTM Standard Test Methods:
      a. D1556 – Density and Unit Weight of Soil In Place by the Sand-Cone Method.
      b. D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.
      c. D2922 – Density of Soil and Soil-Aggregate In Place by Nuclear Methods.
   2. State DOT Current Standards:
      a. Specifications for Construction.

1.4 DEFINITIONS

A. Terms:
   1. Base Course: The layer of specified material of designed thickness placed on a subbase or a subgrade to support a surface course.
   2. Pavement Structure: Combination of subbase, base course, and surface course, including shoulders, placed on a subgrade.
   3. Plan Grade: Vertical control grade indicated on the Drawings.
   4. Roadbed: The portion of the roadway between the outside edges of finished shoulders, or the outside edges of berms back of curbs or gutters, when constructed.
   5. Roadside: The portion of the right-of-way outside of the roadway.
   6. Roadway: The portion of the right-of-way required for construction, limited by the outside edges of slopes and including ditches, channels, and all structures pertaining to the Work.
   7. Shoulder: The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.
   8. Subbase: The layer of specified material of designed thickness placed on the subgrade as a part of the pavement structure.
   9. Subgrade: The portion of the earth grade upon which the pavement is to be placed.

1.5 SUBMITTALS

A. Action Submittals: For aggregate:
   1. Source.
   2. MDOT classification.
   3. Sieve analysis.

1.6 QUALITY ASSURANCE

A. Testing of Aggregate Materials: In accordance with Division 01 Section "Special Inspections and Tests."

B. Compaction:
   1. Determine density by the modified Proctor method, ASTM D1557.
   2. Compact subbase and base course to at least 95% maximum density at a moisture content not greater than optimum.

1.7 PROJECT CONDITIONS

A. Dust Control:
   1. Use all legal means necessary to control dust on and near the Work and on and near off-site borrow areas if such dust is caused by Contractor's operations during performance of the Work or if resulting from the condition of the Site when earthwork operations are suspended.
   2. Moisten or otherwise treat haul roads, delivery roads, temporary Site access roads and other surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the Site.

B. Existing Utility Structures:
   1. Where utility structures are encountered which are in active use:
      a. Provide adequate protection.
      b. Be responsible for damage.
   2. Adjust utility structures to meet plan grade.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Approval Required: Material shall be subject to the approval of Engineer.
   2. Notification: For approval of materials, notify Engineer at least 1 week in advance of intention to import material, designate the proposed stockpile area, and permit independent testing laboratory to sample as necessary from the stockpile area for the purpose of making acceptance tests to prove the quality of the material.

B. Subgrade: In accordance with Division 31 Section “Grading.”

C. Material Source: Imported Material:
   1. Subbase.
   2. Base course.

D. Subbase:
   1. MDOT 902, Granular Material Class II.
   2. Thickness compacted in place: 12 inches.

E. Aggregate Base Course:
   1. MDOT 902, Dense Graded Aggregate 21AA.
   2. Thickness Compacted in Place: 8 inches.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade:
   1. Prepared in accordance with Division 31 Section “Grading.”
   2. Maintain in a smooth and compacted condition until the subbase or base course has been placed.
   3. Proof roll subgrade prior to placing subbase or base course.
   4. No base course shall be placed on the subgrade until it has been approved by Engineer.

3.2 INSTALLATION

A. Subbase:
   1. Smooth, spread and compact.
   2. Place in one layer, provided that the depth of the compacted layer does not exceed 15 inches.
   3. Where the specified depth of subbase is more than 15 inches, place material in layers of approximately equal thickness.
   4. Construct to the grade and cross section as indicated on the Drawings.
   5. Should the subgrade at any time prior to or during the placing of subbase become soft or unstable to the extent that rutting occurs in the subgrade or to the extent that subgrade material is forced up into the subbase materials, the operation of hauling and placing subbase shall be immediately discontinued. Where subgrade material has become mixed with the subbase material, the mixed material shall be removed and disposed of. After the subgrade has been corrected to the specified condition, new subbase material shall be placed and compacted as specified above.
   6. Shape to specified crown and grade within a tolerance of plus 1-inch and maintain in smooth condition.
   7. Do not place on a frozen, soft, unstable or rutted subgrade.
   8. Remove, dispose of and replace subbase material, at Contractor's expense, if it becomes mixed with subgrade material.
   9. Proof roll subbase prior to installation of base course.

B. Base Course:
   1. Do not place aggregate base on frozen, soft, unstable or rutted subgrade, subbase, or aggregate base.
   2. Additives may be used to ease compaction, shaping, and maintenance of the aggregate surface.
   3. Do not rut or distort the subbase material or aggregate base during spreading.
   4. Place in uniform layers to such a depth that when compacted, the course will have the thickness indicated on the Drawings.
   5. The compacted depth of each layer shall not be more than 6 inches nor less than 3 inches.
   6. Compact each layer of aggregate.
   7. Place aggregate shoulder material in conjunction with the top layer of aggregate base material.
   8. Shape to the crown and grade within a tolerance of ± 0.05 feet unless otherwise specified. The surface of each spreading operation shall be continuously maintained in a smooth condition.
   9. Roll the shaped surface, when required, to provide thorough compaction.
   10. Where the existing surface is very irregular, the use of a scarifier may be required. Wetting may be required to facilitate shaping the surface and to assist in providing compaction.
   11. Remove, dispose of and replace aggregate base material, at the Contractor's expense, if it becomes mixed with the subbase or subgrade material.
   12. Final shaping and compacting shall be accomplished by use of a subgrade machine operating on crawler tracks, or by the use of a maintainer or surface planer, with a rigid frame.
   13. If the subgrade, subbase, or aggregate base is damaged due to the Contractor's operations or by traffic, restore to the specified condition at Contractor's expense.

END OF SECTION 32 11 23

SECTION 321213.40 - CONCRETE PLANTER CURBS AND PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental General Conditions, which are hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of concrete planter curbs, walks and paving is shown on drawings.

B. Related Work Specified Elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 SUBMITTALS:

A. Product Data: Submit data for proprietary material and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems and others as requested by Landscape Architect.

B. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.

1. Submit proposed design mix for each type of concrete required.

1.4 QUALITY ASSURANCE:

A. Codes and Standards: Comply with local governing regulations if more stringent than herein specified.

B. Concrete Testing Service: Employ, at Contractor's expense a testing laboratory acceptable to the Landscape Architect to perform material evaluation tests and to design concrete mixes.

C. Tests for Concrete Materials:

1. For Portland Cement, sample cement and determine chemical and physical properties by methods of test of ASTM C-150.
2. Submit written reports to the Owner’s Representative and Landscape Architect for each material sampled and tested prior to the start of work. Provide the project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufacturing materials, values specified in the referenced specification for each material and test results. Indicate whether or not material is acceptable for intended use.
3. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing, when acceptable to the Owner’s Representative and Landscape Architect. Certificates of compliance must be signed by the materials' producer and the Contractor.

1.5 JOB CONDITIONS:

A. Traffic Control:

1. Maintain access for vehicular and pedestrian traffic as required for other construction activities.
2. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Forms:

1. Steel, wood or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
2. Use flexible spring steel forms or laminated boards to form radius bends as required.

B. Concrete Materials: See 2.2

C. Expansion Joint Materials: Refer to Section 079200 – Joint Sealants.

D. Anti-Spalling Compound: 50% (by volume) boiled linseed oil and 50% (by volume) commercial grade kerosene or mineral spirits.

E. Bonding Compound: Styrene butadiene or acrylic base, rewettable type.

2.2 CONCRETE MATERIALS:

A. Portland Cement: ASTM C-150, Type I

1. Type III may be used for high early strength concrete.
2. Use one brand of cement throughout project, unless otherwise acceptable to Landscape Architect.

B. Normal Weight Aggregates:

1. General: ASTM C-33 and as herein specified.

a. Local aggregates not complying with ASTM C-33, but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Landscape Architect.

2. Fine Aggregates: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.

a. Dune sand, bank run sand and manufactured sand are not acceptable.

3. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam or foreign matter, as follows:

a. Crushed stone, processed from natural rock or stone.

b. Washed gravel, either natural or crushed. Use of pit or bank run gravel not permitted.
c. Maximum Aggregate Size: Not larger than one-fifth of narrowest dimensions between sides of forms, one-third of depth of slabs, nor three-fourths of minimum clear spacing between individual reinforcing bars or bundles of bars.
d. Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18% for large top size aggregates (1 1/2 inch) or 8% - 22% for smaller top size aggregates (1 inch or 3/4 inch) retained on each sieve below the top size and above the No. 100.

4. Supplementary Cementitious Materials:

a. Fly Ash ASTM C618, Type F may be used up to a maximum of 25% of the total cementitious content.
b. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120 may be used up to a maximum of 40% of the total cementitious content.
c. The exact percentage of supplementary cementitious materials used shall be based on a successful test placement on-site.
d. In mass concrete, more than 2 feet thick, the usage may be 50% for fly ash and 80% for slag.

C. Water: Drinkable

D. Air-Entraining Admixture: ASTM C-260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "AEA-92 or Air 40": Euclid Chemical Co.
b. "Sika Aer": Sika Corp.
c. "MB-VR or MB-AE": BASF Admixture Systems

E. Water-Reducing Admixture: ASTM C-494, Type A, and contain not more than 0.05% chloride ions.

1. Products: Subject to compliance with requirements provide one of the following:

a. "Eucon WR-75 or Eucon WR 91": Euclid Chemical Co.
b. "Possolith 322N": BASF Admixture Systems
c. "Plastocrete 160": Sika Chemical Corp.

F. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C-494, Type F or Type G and contain not more than 0.05%chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Daracem 100 or AdvaFlow": W. R. Grace
b. "Eucon 37/Eucon 1037, or Plastol Series": Euclid Chemical Co.
c. "Rheobuild 1000 or Glenium Series": BASF Admixture Systems

G. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C-494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. <u>The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.</u>

1. Products: Subject to compliance with requirements, provide one of the following:

   a. "Accelguard 80/90 or NCA": Euclid Chemical Co.
   b. Pozzutec 20+: BASF Admixture Systems

H. Water-Reducing, Retarding Admixture: ASTM C-494, Type D, and contain not more than 0.05% chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. "Pozzolith Retarder": Master Builders
   b. "Eucon Retarder 75 or Eucon Retarder 100": Euclid Chemical Co.
   c. "Plastiment": Sika Chemical Co.

I. Certification: Provide admixture manufacturer's written certification that chloride ion content complies with specified requirements.

J. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.05% chloride ions are not permitted.

K. Curing materials: Liquid membrane curing compound, ASTM C-309, Type I, Class A manufactured by W.R. Meadows ph. (800) 342-5976 or equal.

2.3 REINFORCING MATERIALS:

A. Reinforcing Bars: ASTM A-615, Grade 60. (Size as shown on drawings.)

B. Welded Wire Fabric: ASTM A-185 welded steel wire fabric, 6X6W2.9 X W2.9 or size as shown on drawings.

2.4 FORMS:

A. Contractor shall be responsible for design and engineering of formwork. Formwork shall comply with local code requirements and ACI 347, “Recommended Practice for Concrete Formwork”.

B. Unless otherwise specified herein, concrete materials, mixing and placing shall conform to requirements of ACI 304 “Recommended Practice for Measuring, Mixing, and Placing Concrete”.

C. Comply with ACI 318 Building Code Requirements for Reinforced Concrete for all fabrication and application or reinforcing.

2.5 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301, Section 4.3.1. If trial batch method used, use an independent testing facility acceptable to the Landscape Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing, unless otherwise acceptable to the Landscape Architect.

B. Submit written reports to the Owner’s Representative and Landscape Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Submit mix designs on the mix design submittal form included at the end of this specification. Do not begin

concrete production until mixes have been reviewed by the Owner's Representative and Landscape Architect.

C. Design mixes to provide normal weight concrete with the following properties and additives:

1. Exterior Concrete: 4000 psi 28-day compressive strength; W/Cm 0.45 (0.40 if reinforced), 6% ± 1.5% air content.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results or other circumstances warrant; at no additional cost to Owner and as accepted by the Owner's Representative and Landscape Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by the Owner's Representative and Landscape Architect before using in work.

E. Admixtures:

1. Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F (10 degrees C).
3. Use high-range water-reducing admixture in pumped concrete, architectural concrete, fiber concrete and concrete with water/cementitious ratios below 0.50.
4. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 1-1/2% within following limits:

   a. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals or subjected to hydraulic pressure.

      1) 5.5% 1-1/2" maximum aggregate
      2) 6.0% 1" maximum aggregate
      3) 6.5% 3/4" maximum aggregate
      4) 7.0% 1/2" maximum aggregate

   b. Other Concrete (not exposed to freezing, thawing or hydraulic pressure): 2% to 4% air.

5. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

F. Water-Cement Ratio: All concrete subject to freezing and thawing shall have a maximum water/cementitious ratio of 0.50 (4000 psi at 28 days or more). All concrete subjected to deicers and/or required to be watertight shall have a maximum water/cementitious ratio of 0.45 (4500 psi at 28 days or more). All reinforced concrete subjected to brackish water, salt spray or deicers shall have a maximum water/cementitious ratio of 0.40 (5000 psi at 28 days or more). All trowel finished interior slabs, subjected to vehicular traffic, shall have a maximum w/c ratio of 0.53.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, Slabs and Sloping Surfaces: Not more than 3".

2. Concrete Containing HRWR Admixture (super plasticizer): Not more than 9" after addition of HRWR to site verified 2"-3" slump concrete.
3. Other Concrete: Not more than 4".

2.6 CONCRETE MIXING:

A. Ready-Mix Concrete: Comply with requirements of ASTM C-94, and as herein specified:

1. During hot weather or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C-94 may be required.

a. When air temperature is between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes and when air temperature is above 90 degrees F (32 degrees C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine the areas and conditions under which concrete curbs and paving are to be installed and notify the Owner's Representative and Landscape Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 SURFACE PREPARATION:

A. Remove loose material from the compacted subbase surface immediately before placing concrete.

B. Proof-roll prepared subbase surface to check for unstable areas and the need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.3 FORM CONSTRUCTION:

A. Set forms to the required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of the work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork for grade and alignment to the following tolerances:

1. Top of forms not more than 1/8" in 10'.
2. Vertical face on longitudinal axis, not more than 1/4" in 10'.

C. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

3.4 CONCRETE PLACEMENT:

A. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

B. Place concrete using methods which prevent segregation of the mix. Consolidate concrete along the face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement or side forms. Use only square faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels and joint devices.

1. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place a construction joint.

3.5 JOINTS:

A. General: Construct expansion, weakened-plane (contraction) and construction joints true-to-line with face perpendicular to surface of the concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

1. When joining existing structure, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown on drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness. Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

C. Construction Joints: Place construction joints at the end of all pours and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such pours terminate at expansion joints. Use diamond dowels in construction joints of non-reinforced slabs on grade.

D. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.

1. Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If not joint sealer, place top joint filler flush with finished concrete surface.
2. Furnish joint fillers in one-piece lengths for the full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
3. Protect the top edge of the joint filler during concrete replacement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

3.6 CONCRETE FINISHING:

A. After striking-off and consolidating concrete, smooth the surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust the floating to compare the surface and produce a uniform texture.

B. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing, as shown on drawings and as acceptable to the Owner's Representative and Landscape Architect.

C. Do not remove forms for 24 hours after concrete has been placed. After removal, clean ends of joints and point-up any minor honeycomb areas. Remove and replace areas or sections with major defects, as directed by the Owner's Representative and Landscape Architect.

D. Work edges of slabs, back top edge of curb and formed joints with an edging tool and round to 1/2" radius, unless otherwise indicated. Eliminate tool marks on concrete surface. Install beveled sawcuts where indicated.

3.7 CONCRETE CURING AND PROTECTION:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Method: Perform curing of concrete by moist curing, by moisture-retaining cover curing and by combinations thereof, as herein specified. Use methods 1 or 2 where subsequent surface treatments will be applied to concrete.

1. Provide Moisture Curing by Following Methods:

a. Keep concrete surface continuously wet by covering with water.
b. Continuous water-fog spray.
c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

2. Provide Moisture-Cover Curing as Follows:

a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproofing tape.

3. Provide Membrane Forming Curing Compound:

a. Apply per manufacturer's recommendation.

C. Curing Formed Surfaces: Cure formed concrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

D. Curing Unformed Surfaces: Cure Unformed surfaces and other flat surfaces by use of moisture-retaining cover, unless otherwise directed.

E. Anti-Spalling Treatment: Apply compound to concrete surfaces not receiving protective sealer finish no sooner than 28 days after placement. Apply to clean, dry concrete free of oil, dirt and

other foreign materials, in 2 sprayed applications. First application at rate of 40 yds. per gal.; second application, 60 sq. yds. per gal. Allow complete drying between applications.

3.8 REPAIRS AND PROTECTIONS:

A. Repair or replace broken or defective concrete as directed by the Owner's Representative and Landscape Architect.

B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

C. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

3.9 QUALITY CONTROL TESTING DURING CONSTRUCTION:

A. The Contractor to employ a testing laboratory to perform tests and to submit test reports.

B. Sampling and testing for quality control curing placement of concrete may include the following, as directed by the Owner's Representative and Landscape Architect.

1. Sampling Fresh Concrete: ASTM C-172, except modified for slump to comply with ASTM C-94.

a. Water Content and Slump: Verify Water Content in accordance with AASHTO T-318 "Standard Method of Test for Water Content Using Microwave Oven Drying". Test Slump in accordance with ASTM C-143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
b. Air Content: ASTM C-173, volumetric method or ASTM C-231 pressure method; one for each day's pour of each type of air-entraining concrete.
c. Concrete Temperature: Test hourly when air temperature is 40 degrees F (4 degrees C) and below, and when 80 degrees F (27 degrees C) and above; and each time a set of compression test specimens made.
d. Compression Test Specimen: ASTM C-31; one set of 3 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
e. Compressive Strength Tests: ASTM C-39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, one specimen tested at 28 days and one specimen retained in reserve for later testing if required.
f. When frequency of testing will provide less than 4 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
g. When total quantity of a given class of concrete is less than 50 cu. yd., strength test may be waived by the Owner's Representative and Landscape Architect if, in his judgment, adequate evidence of satisfactory strength is provided.
h. When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

i. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.

C. Test results to be reported in writing to the Owner's Representative, Landscape Architect, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-days test.

D. Nondestructive Testing: Impact hammer, sonoscope or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

E. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Owner's Representative and Landscape Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C-42 or by other methods as directed. Contractor shall pay for such tests conducted and any other additional testing as may be required, when unacceptable concrete is verified.

F. Non-Compliant Test Reports: All test reports indicating non-compliance should be e-mailed or faxed immediately to all parties on the test report distribution list. Copies shall be on different colored paper.

END OF SECTION 321213.40

SECTION 32 12 16 – ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of the Hot Mix Asphalt (HMA) base course, HMA leveling course, and HMA surface course.

1.3 REFERENCES

A. Comply with standards in effect as of the date of the Contract Documents except for those having different revision dates as referenced in the codes or as indicated on the Drawings.

B. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM – Current Standards:
      a. D977 – Standard Specification for Emulsified Asphalt.
      b. D979 – Sampling Bituminous Paving Mixtures.
      c. D1188 – Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.
      d. D2041 – Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixture
      e. D2950 – Test Method for Density of Bituminous Concrete in Place by Nuclear Method.
      f. D2995 – Estimating Application Rate of Bituminous Distributors.
   2. Asphalt Institute (AI):
      a. MS-2 Mix Design Methods.
      b. SP-1 Performance Grade Asphalt Binder Specification and Testing.
      c. IS-210 Procedures for Improving the Precision of HMA Volumetric Calculations.
   3. AASHTO – Current Standards:
      a. M 323 Standard Specification for Superpave Volumetric Mix Design.
      b. MP-1 Superpave Performance-Graded Binder Specification.
      c. MP-15 Use of Recycled Asphalt Shingles as an Additive in HMA Mixtures.
      d. PP-53 Design Considerations When Using Recycled Asphalt Shingles in New HMA Mixtures.
      e. T 245 – Resistance to Plastic Flow of Bituminous Mixtures using a Marshall Apparatus.
      f. T 283 – Moisture Susceptibility of Asphaltic Concrete Mixtures.
      g. T 304 – Uncompacted Void Content of Fine Aggregate, Method A.
      h. T 312: Preparing and Determining the Density of Hot-Mix Asphalt Specimens by Means of the Superpave Gyratory Compactor.
   4. United States Department of Transportation – Federal Highway Administration:
      a. Manual on Uniform Traffic Control Devices (MUTCD).
   5. State DOT Current Standards:
      a. Standard Specifications for Construction.
      b. Standard Plans.
      c. Design Pavement Guidelines
      d. Manual on Uniform Traffic Control Devices.

1.4 SUBMITTALS

A. HMA Mix Design:
   1. Job Mix Formula (JMF) previously approved by state DOT.
      a. Michigan DOT Form 1931
      b. Other States: Submit state DOT form indicating preapproved DOT mix design and required documentation.

2. Job Mix Formula (JMF) not previously approved by state DOT:
   a. Michigan: MDOT 1855 mod form or Form 1911 with regression table.
   b. Other States: Submit DOT or other suitable bituminous mix design communication with all required information to evaluate mix design in accordance with current standards
3. Aggregates:
   a. Source, type, gradation and other required information to evaluate aggregates in accordance with current standards.
   b. Certification that aggregates used in HMA mix meet DOT specifications.

B. Quality Assurance/Control Submittals: Contractor's Quality Control Plan for projects with more than 1,500 tons or greater than 1 day paving

C. Provide a detailed schedule for construction.

1.5 QUALITY ASSURANCE

A. Pre-Paving Meeting:
   1. Required for projects greater than 1,500 tons or more than 1 day paving;
   2. Optional for projects less than 1,500 tons or 1 day paving.
   3. Meeting held at a time mutually agreed upon with Engineer, Owner (optional), Contractor and subcontractors involved in the paving work.
   4. Discussion of proposed schedule and methods of accomplishing all phases of the paving work.
   5. Minutes distributed to all in attendance.

B. Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design.

C. Testing of HMA Materials:
   1. In accordance with Division 01 Section "Testing Services for Buried Utilities, Roadways, and Site Projects."
   2. In accordance with approved Contractor's Quality Control Plan.
   3. In accordance with all applicable standards.

D. Weight Slips: Furnish weight slips to Engineer, or engineer's representative for material incorporated in the Project to verify that the required tonnage has been applied.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation.

B. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reclaimed Asphaltic Materials (RAM):
   1. Reclaimed Asphalt Pavement (RAP) and/or Fractionated Reclaimed Asphalt Pavement (FRAP) as percent of total weight of the mixture:
      a. HMA Base: Maximum 27%. State DOT blending requirements; AASHTO M323.
      b. HMA Binder/Leveling: Maximum 25%. Use virgin binder one grade softer, for both high and low temperature, than specified if RAP greater than 20%.
      c. HMA Surface: Maximum 17%. No change in binder selection.
      d. HMA Mixtures With Polymer Asphalt: Maximum 10%.

e. Greater than 25% RAP/FRAP or Combination: Use virgin asphalt binder grade in accordance with State DOT blending requirements and AASHTO M 323.

2. Reclaimed Asphalt Shingles (RAS):
   a. In accordance with State DOT requirements.
   b. May replace up to 5% of RAP/FRAP component in HMA mixture, but no more than 17% by weight of the total binder content for any HMA mixture.
   c. Maximum Particle size = 1/2 inch.
   d. Maximum deleterious materials = 1.5%
3. Bond Coat: SS-1h, CSS-1h.
4. Base/Leveling Course:
   a. HMA Mixture: MDOT 4EM.
   b. Asphalt Cement PG: 64 -28.
   c. Air voids modified to 3% using regression for light traffic applications.
5. Top Course:
   a. HMA Mixture: MDOT 5EML.
   b. Asphalt Cement PG: 64 -28.
   c. Air voids modified to 3% using regression for light traffic applications.

2.2 EQUIPMENT

A. Pavers:
1. Provide an approved self-powered machine capable of spreading and finishing the bituminous mixture to the cross section and grade as indicated on the Drawings.
   a. Supporting wheels, treads, or other devices that ride on the prepared base.
   b. Screeds the full width of the bituminous mixture being applied using an oscillating or vibrating screed.
   c. Equipped with a hopper and an automatic material-depth control device so that each distributing auger and corresponding feeder responds automatically to provide for a constant level of mix ahead of the screed unit to the full width being paved.
2. Provide paver with approved automatic screed control:
   a. System of sensor-operated devices, which follow reference lines or surfaces on one or both sides of the paver.
   b. Adjust speed of the paver to produce the best results.
3. When approved extensions are added to the main screed, provide with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas.
   a. Equip the extensions with a continuation of the automatically controlled spreading augers to within 18 inches of the outside edge of the extension, or as directed.
   b. Provide the main screed and any extensions with an approved method of heat distribution and retention.
4. For Shoulders and Widening:
   a. A self-propelled mechanical spreader capable of maintaining the proper width, depth, and slope without causing segregation of the material.
   b. For base courses up to 10-1/2 feet in width and for leveling and top courses up to 8 feet in width.

B. Rollers:
1. Provide rollers and maintain rolling patterns to achieve required densities to produce a neat, tightly bonded joint that meets surface tolerances
2. Steel-Wheeled Rollers:
   a. Self-propelled, vibratory or static, tandem rollers; or self-propelled static 3-wheeled rollers.
   b. Vibratory Rollers:
      1) Capable of reversing without backlash and equipped with spray attachment for moistening all rollers and scrapers.
      2) Frequency of at least 2,400 vpm and amplitude setting low.
      3) Equipped with a shutoff to deactivate the vibrators when roller speed is less than 0.5 mph and provision to lock in the manufacturer's recommended speed.
3. Pneumatic-Tired Rollers:
   a. Self-propelled type with a total weight, including ballast, not less than 8 tons nor greater than 30 tons.

b. Equipped with a minimum of 7 wheels situated on the axles in such a way that the rear group of tires will not follow in the tracks of the forward group, but will be so spaced that a minimum tire path overlap of 1/2-inch is obtained.
c. Smooth tires capable of being inflated to the pressure recommended by the Manufacturer of the roller or as directed.
d. Tire Pressures: Maximum variation 5 psi.

PART 3 - EXECUTION

3.1 PREPARATION

A. Test subgrade, subbase or aggregate base for density.
1. Rework surfaces that have become too wet or dry to provide the required density. Do not pave on wet or saturated aggregates.
2. Required Density: Minimum 95% of Maximum Density ASTM D1557.

B. Proof or Test Rolling:
1. Field test the uniformity and stability of the subgrade and subbase.
2. Loaded dump truck or other approved equipment over entire area in each of 2 perpendicular directions.
3. Areas indicated or as designated by Engineer or field representative.
4. In presence of Engineer or field representative.
5. Repair/undercut unstable or yielding areas as directed.

C. Fine Grading:
1. Immediately prior to placing paving materials, test the subgrade or aggregate base course for conformity to the elevations and cross-section as indicated on the Drawings.
2. Fine grade as necessary to bring base course into conformance with the proper elevation and cross-section.
3. Compact areas which have been re-graded to minimum 95% Maximum Density ASTM D1557.

D. Do not place HMA material until the surface to be paved upon has been inspected and approved by Engineer.

E. Immediately before placing the bituminous material, remove excess loose material remaining on the surface.

3.2 INSTALLATION

A. Weather and Seasonal Limitations:
1. As required by DOT Construction Specifications.
2. Do not schedule paving if local radar shows rain in forecast, unless paving can be completed prior to rain event.

B. Transportation of Mixtures
1. Use trucks that have tight, clean, smooth metal beds from which the entire quantity of the mixture is discharged smoothly into the spreading equipment.
2. Maintain temperature of the mixture discharge from the hauling unit at the target placement temperature or as directed.
a. Acceptance Range for HMA at Point of Discharge:
1) Minimum 250 degrees F to maximum 350 degrees F.
2) HMA mixes less than 250 degrees F or greater than 350 degrees F at point of discharge:
a) Do not place mix unless approved by Engineer.
b) Remove mix from Site and dispose off Site unless approved by Engineer.
c) No additional cost to project.
b. If transporting at prevailing temperature below 50 degrees F or when haul times exceed 30 minutes, insulate truck beds and ensure all covers are fastened.
3. Apply approved release agent to hauling unit to prevent adhesion of the mixture to the bed surface.

C. Placement of the Mixture:
   1. To the fullest extent practicable, spread all mixtures with an asphalt paver.
      a. In areas inaccessible to a paver, mixtures may be spread with a motor grader or mechanical device approved by the Engineer.
      b. Complete placement of each course over the full width of the section under construction on each day's run unless otherwise directed by the Engineer.
   2. Provide a uniformly finished surface at all times, free from tearing or other blemishes that would require hand work.
   3. Spread all mixtures without segregation to the cross sections indicated on the Drawings.
   4. When paving ramps or shoulders, or when the grade of a concrete gutter or other existing installation must be met, use the automatic grade reference and slope control devices as directed.
   5. Whenever a breakdown or malfunction of the automatic controls occurs, operate the equipment manually for the remainder of the normal working day, provided this method of operation will produce results as required.
   6. Coordinate the spreading of the mixture with the required roller coverage, considering the rate of cooling of the mixture as affected by lift thickness and environmental conditions.
   7. Coordinate the work such that at the completion of each day's paving operations, all lanes will have been resurfaced to within 1 load of the same point-of-ending.

D. Placing Bituminous Leveling and Top Course Mixtures:
   1. Place HMA in lifts not to exceed the maximum application rates as recommended by State DOT for the mixture specified.
   2. Place the HMA mixture by an approved self-propelled mechanical paver to such a depth that when compacted, it will have the thickness specified or as directed
   3. Adjust the paver to that speed which gives the best results for the type of paver being used and which coordinates satisfactorily with the rate of delivery of the mixture to the paver to provide a uniform rate of placing the mixture without intermittent operation of the paver.
   4. When delays result in slowing paving operations such that the temperature of the mat immediately behind the screed falls below 200 degrees F:
      a. Stop paving and place a transverse construction joint.
      b. If the temperature of the mat falls below 190 degrees F prior to any rolling – remove and replace the mat at Contractor's expense.
   5. Place the HMA mixture to the required cross section and as indicated on the Drawings.
   6. Whenever the temperature of the previously placed mat falls below 170 degrees F prior to placement of the adjacent mat:
      a. Tack coat the vertical edges of the initial mat with bituminous bond coat material before the mixture is placed on the adjacent section.
      b. In placing the mixture adjacent to joints, and rake or broom to provide a dense smooth connection.
   7. Connections with existing surfaces at the beginning and ending of resurfacing sections and at intersections.
      a. Construct by feathering out the mix at the rate of approximately 1-inch per 25 feet, unless butt joints are used.
      b. After compaction has been completed, spray the first 3 feet of the joint and 1-foot of area not surfaced with bituminous bond coat, sanded, and rolled.
      c. This work shall be accomplished within the concurrent construction season.
   8. If the lanes are being constructed with 2 or more pavers in echelon, match the loose depth of bituminous mixture from each paver at the longitudinal joints.
   9. Thickness: In place compacted thickness tested in accordance with ASTM D3549.
      a. Thickness must be within 1/4-inch of specified thickness during both leveling and top course paving.
   10. Smoothness requirements: After final rolling, the surface may be tested longitudinally by Engineer using a 10-foot straightedge at selected locations. The variation of the surface from the testing edge for the straightedge between any 2 contacts with the surface shall at no point exceed the following limits:
      a. For HMA Base Course Mixtures:
         1) For Lower Courses: 3/4-inch.
         2) For Top Course: 3/8-inch.
      b. For HMA Leveling and Top Course Mixtures:
         1) Multiple Course Construction: 1/8-inch for top course, 1/4-inch for lower courses.
         2) Single Course Construction: 1/4-inch.

c. Pavement at castings and valve boxes must be flush or a maximum of 1/4-inch higher than casting. In no case shall casting be higher than pavement.
d. Any bird bath remaining after 24 hours after a rain event is unacceptable and subject to Engineers direction for remediation. Possible repairs might include saw cut and removal or reheating and rolling pavement to eliminate bird bath.

11. Correct variations in excess of the specified tolerance as directed. Remove and replace pavement as directed by Engineer.
12. Weighing Loads: Each load of bituminous mixture accepted by Engineer shall be weighed to the nearest 20 pounds on an approved scale having an automatic print-out system.
13. Weather and Seasonal Limitations:
    a. Do not place HMA or apply tack/bond coat when precipitation is imminent or when surface moisture will prevent satisfactory curing.
    b. Unless otherwise approved by Engineer in writing, temperature requirements for placing HMA mixtures will be in accordance with the table below.
    c. HMA paving will not be allowed below minimum temperatures in table or when there is frost on or in the grade or on the existing surface.

Target Placement Temperatures			
Temperature of the Surface Being Overlaid	Rate of Application of Bituminous Material (lbs/square yard)		
	<120	120 to 200	> 200
35 to 39			330 degrees F
40 to 49		330 degrees F	315 degrees F
50 to 59	330 degrees F	315 degrees F	300 degrees F
60 to 69	315 degrees F	300 degrees F	285 degrees F
70 to 79	300 degrees F	285 degrees F	270 degrees F
80 to 89	285 degrees F	270 degrees F	270 degrees F
90 and over	270 degrees F	270 degrees F	270 degrees F

E. Rolling:
1. Compact each layer of HMA to the required density, free of all roller marks.
2. Begin rolling of the HMA mixture as soon after placing as it will bear the roller without undue displacement, picking up the mat, or cracking.
    a. Roll longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the drive wheel of the roller.
    b. Complete alternate passes of the roller using slightly different lengths.
3. Complete the required roller coverage during the period of time in which the temperature of the mixture is sufficient for the roller coverage to be effective in compaction of the mixture.
4. Use tandem steel-wheeled rollers for the final rolling operation on each layer of HMA.
5. Keep surface of steel rollers completely moist with water when rolling.
6. Operate vibratory rollers in the static mode when used for finish rolling or pinching the joint.
7. In Areas Inaccessible to Rollers:
    a. Thoroughly compact the mixture with hot, hand tampers or with mechanical tampers.
    b. Trench rollers or rollers filled with compression strips may be used in depressed areas.

F. Bond or Tack Coat:
1. Clean contact surfaces of sand, dirt, or other objectionable material before applying bond coat.
2. Apply to existing bituminous material and to the vertical edge of the adjacent pavement or curb and gutter, prior to applying new bituminous when:
    a. Paving over milled surface.
    b. Paving over old pavement.

c. Paving over new pavement.
d. Adjacent pavement face that is below 170 degrees F.

3. Distributor Vehicle:
   a. Use identical overlapping nozzle spray pattern.
   b. Maintain temperature and pressure that result in a constant uniform application rate.
   c. Provide means for determination of the volume of tack applied to a surface area.
4. Apply tack coat to vertical surfaces and provide uniform application.
5. Application Rate:
   a. 0.05 to 0.1 gallons per square yard for paved surfaces.
   b. Increase application rate 20 to 30% for milled or very rough surfaces.
   c. Increase application rate 50% for vertical edge of adjacent pavement or structure.
   d. Calculate yield by dividing gallons used by square yards covered.
6. Prevent bond or tack coat from coming into contact with structures near the areas to be paved.
7. Allow emulsified asphalt tack coat to break, as indicated by color change from brown to black before HMA paving is placed.
8. Do not place tack coat if local radar shows rain in forecast, unless paving can be completed prior to rain event.

G. Acceptance Density Range:
   1. Low Volume Roads/Parking Lots:
      a. Acceptable Range: 93 to 97% of the TMD.
      b. Average Daily Density: ≥ 94%.
   2. Medium/Heavy Volume Roads:
      a. Acceptable Range: 92 to 96% of the TMD.
      b. Average Daily Density: ≥ 93%.
   3. For smaller projects, the engineer may elect to accept the project without density testing:
      a. Compact all patching, widening, wedging, base, leveling and surface layers of asphalt paving until no further consolidation is visible under the action of the compacting equipment and roller marks are eliminated
      b. Use two or more rollers per paver if placing more than approximately 165 tons of mixture per hour.
      c. Basis of Acceptance: Engineer's visual examination.

H. Construction Joints:
   1. Thoroughly compact all joints to produce a neat, tightly bonded joint that meets surface tolerances and density requirements.
   2. Transverse Joints:
      a. Construct when mixture placement operations are suspended
      b. Thoroughly compact the forward end by rolling before the mixture has cooled.
      c. When work is resumed, vertically cut the end for full depth of the layer unless a formed edge is constructed as approved by the Engineer.
      d. When road must remain open to traffic construct temporary taper before allowing traffic on new surface:
         1) Cut vertical joint and remove excess HMA.
         2) Place burlap, canvas or paper as a bond breaker ahead of and against the vertical face.
         3) Place HMA against the bond breaker and taper from new mat to existing surface.
         4) Extend temporary taper 5 feet for each inch of mat thickness or as directed by Engineer.
         5) Thoroughly compact and cool the temporary taper.
   3. Longitudinal Joints:
      a. Construct parallel to centerline of road.
      b. Multiple Lift Construction: Offset minimum 6 inches from previously placed joint.
      c. Vertical Longitudinal Joint:
         1) Apply uniform tack coat over joint face of existing pavement with a surface temperature less than 170 degrees F.
         2) Place HMA so that it uniformly overlaps the first lane approximately 1 inch
         3) Roll the longitudinal joint from the hot side, 1/2 foot to 1 foot away from the joint for the first pass.
         4) Subsequent Passes: Overlap the cold side by 1/2-foot to 1 foot.
      d. Tapered Overlapping Longitudinal Joint:
         1) Taper the HMA mat at the slope no greater than 1:12.
         2) Extend tapered portion beyond the lane width.

3) Place 1/2-inch to 1 inch notch at the top of the taper on all courses of paving.
4) Compact the formed taper section with a weighted roller as wide as the taper.
5) Apply uniform tack coat to the surface of the taper before the adjacent lane is placed.

e. Longitudinal Joint Compaction:
1) Joint Density: Minimum 90% TMD (G_{mm}).
2) Joint Density with echelon paving; same as adjacent mat.

3.3 CLEANING

A. Prior to acceptance of the work, clean the pavement and related areas to remove dirt and stones.

END OF SECTION 32 12 16

SECTION 32 13 13 – CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of form work, reinforcement, and concrete pavement for exterior work:
   1. Driveways and roadways.
   2. Parking lots.
   3. Curbs and gutters.
   4. Walkways.
   5. Miscellaneous exterior concrete pavement.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Publications:
      a. A185 – Steel Welded Wire, Fabric, Plain for Concrete Reinforcement.
      b. A615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
      c. A775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
      d. A820 – Steel Fibers for Fiber Reinforced Concrete.
      e. C33 – Specification for Concrete Aggregates.
      f. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      g. C94 – Specification for Ready-Mixed Concrete.
      h. C136 – Sieve Analysis of Fine and Coarse Aggregates.
      i. C150 – Specification for Portland Cement.
      j. C260 – Specification for Air-Entraining Admixtures for Concrete.
      k. C309 – Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      l. C330 – Specification for Lightweight Aggregates for Structural Concrete.
      m. C494 – Specification for Chemical Admixtures for Concrete.
      n. C595 – Specification for Blended Hydraulic Cements.
      o. C618 – Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
      p. C989 – Ground Granulated Blast Furnace Slag (GGBFS) For Use in Concrete and Mortars.
      q. C1116 – Standard Specification for Fiber Reinforced Concrete and Shotcrete.
      r. C1260 – Potential Alkali Reactivity of Aggregates (Mortar-bar method).
      s. C1293 – Determination of Length Change of Concrete Due to Alkali-silica Reaction (Concrete prism test).
      t. C1567 – Potential alkali-silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-bar method).
      u. D3963/D and 3963M – Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
   2. ACI – American Concrete Institute:
      a. 117 – Standard Tolerances for Concrete Construction and Materials.
      b. 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
      c. 224 3R – Joints in Concrete Construction.
      d. 302.1R – Guide for Concrete Floor and Slab Construction.
      e. 303R – Guide to Cast-In-Place Architectural Concrete Practice.
      f. 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
      g. 304.2R – Placing Concrete by Pumping Methods.
      h. 305R – Hot Weather Concreting.
      i. 306R – Cold Weather Concreting.

j. 309R – Guide for Consolidation of Concrete.
k. 330 – Guide for Design and Construction of Concrete Parking Lots.
l. 360 – Design of Slabs on Grade.

3. Concrete Reinforcing Steel Institute (CRSI):
   a. Manual of Standard Practice – current edition.
   b. Placing Reinforcing Bars – current edition.
4. Americans with Disabilities Act (ADA).
5. State DOT Standards:
   a. Specifications for Construction – current edition.
   b. Standard Plans.

1.4 SUBMITTALS

A. Action Submittals:
   1. Provide mix design(s) for concrete to be supplied.
      a. Include quantities and sources of all aggregates, cement, cementitious materials, and admixtures to be used.
      b. Submitted from a state DOT certified testing laboratory regularly engaged in designing and testing concrete for exterior paving.
      c. Use test results for mix design from within the past 12 months.
   2. Product Data: Submit Manufacturer's product data with application and installation instructions for admixtures, curing compounds, expansion joint fillers and sealants.
   3. Alkali-Silica Reactivity (ASR):
      a. Submit to Engineer ASTM C1260 Accelerated mortar bar test, and ASTM C1293 Concrete prism expansion for ASR from fine aggregate supplier.
      b. Documentation may include previous testing (within previous 2 years) of materials and sources intended for use.
      c. Documentation may include previous testing (within previous 2 years) from other projects or records provided by the material suppliers.

1.5 QUALITY ASSURANCE

A. Testing: Testing will be performed in accordance with Division 01 Section "Testing Services for Buried Utilities, Roadways, and Site Projects" and the Contractor's Quality Control Plan.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Reinforcement:
   1. Welded wire fabric in accordance with ASTM A185, yield stress 65,000 psi.
   2. Reinforcing bars in accordance with ASTM A615, yield stress 60,000 psi.

B. Cement:
   1. Portland Cement: ASTM C150, Type I or I/II.
   2. Portland Limestone Cement: ASTM C595, Type IL.
   3. Do not use different Manufacturers of cement, or different degrees of fineness.

C. Cementitious Materials or Cement Substitutes:
   1. Fly Ash: ASTM C618, Class C .
   2. Ground Granulated Blast Furnace Slag (GGBFS):
      a. ASTM C989 Grade 100 minimum.
      b. Use only as a blending material with Type I or Type IA Portland cement.
   3. Silica Fume, Dry-Densified:
      a. ASTM C1240.
      b. Use only as a blending material with Type I or Type IA Portland cement.
   4. Reduce the cement quantity up to a maximum of 25% for fly ash substitution or up to 40% for GGBFS substitution.

5. Fly ash or GGBFS weight additions must equal the weight of the cement reduction.
6. For concrete containing Portland cement, fly ash and GGBFS in the same mix design, reduce the cement quantity up to 40%, with the maximum fly ash quantity not exceeding 15%.

D. Aggregates:
1. Grade aggregates according to procedures of ASTM C136, Class M, Exposure 4.
2. Coarse Aggregates: ASTM C33, Number 57 (1-inch), crushed limestone.
3. Fine Aggregate: ASTM C33.
4. Test fine aggregates for alkali-silica reactivity and provide mitigation method, if required.

E. Water: Clean, fresh and potable.

F. Steel Reinforcement:
1. Deformed bars that conform to ASTM A706 or Grade 60 steel bars ASTM A615.
2. Bars for Dowels or Lane Ties: Conform to Grade 40 ASTM A615 or A617.
3. Welded Wire Fabric: Conform to ASTM A185.
4. Epoxy Coating:
   a. Where required, conform to ASTM D3963/D3963M.
   b. Select coating material from State DOT qualified products list.
   c. Provide certification, if required by Engineer, that material conforms to standards.
   d. Use bar chairs and wire ties that are plastic coated, epoxy coated or plastic.

G. Epoxy Coating Material:
1. Corrosion Protection Coatings:
   a. One part, heat curable, thermosetting powdered epoxy.
   b. Conforming with ASTM A775.
2. Epoxy Coating Patching Material:
   a. Compatible with factory applied epoxy coating.
   b. Conforming with ASTM A775.

H. Synthetic Fibers:
1. Synthetic fibers are fibers manufactured from polymer-based materials such as polypropylene, nylon and polyethylene terephthalate
2. Virgin monofilament or fibrillated polypropylene designed for use in concrete pavement that meets the requirements of ASTM C1116, Type III.
   a. Specific Gravity: 0.91.
   b. Tenile Strength: 40 to 60 ksi.
   c. Length: 1/2-inch minimum; 1-inch maximum.
   d. Application Rate: 1.5 lb/cyd.
   e. GCP: SINTA Microfibers; Sika: Fibermesh 150: Nycon: Procon-F; or approved equal.

I. Admixtures:
1. General:
   a. No admixture shall contain more than 0.1% water soluble chloride ions by mass of cementitious material.
   b. No admixture shall contain calcium chloride.
2. Air-Entraining:
   a. Required in all mixtures.
   b. Comply with ASTM C260.
   c. Daravair series or Darex series, by W.R. Grace & Company; Micro Air, by BASF Admixtures, Inc.; or equal.
3. Water-Reducing Admixtures:
   a. Provide concrete mixtures with the same strength, air content as the respective concrete without the admixture.
   b. Select water reducing admixtures from the state DOT's qualified products list.
   c. Admixture dosage rates are based on the total cementitious material (cement plus fly ash or GGBFS).

J. Curing Agents:
   1. Comply with ASTM C309.
   2. Provide approved products by Symons Corporation, W.R. Meadows, L & M Chemical, Master Builders or Dayton-Superior which are compatible with floor coatings or toppings specified.
   3. Compounds for Curing:
      a. 1100 Clear by W.R. Meadows.
      b. Day-Chem Rez Cure (J-11-W) by Dayton Superior.
      c. Resi-Chem Clear Cure by Symons.
      d. Confilm by Master Builders.
      e. L & M Cure by L & M Chemical.

2.2 CONCRETE MIX DESIGN

A. Design mix to project normal-weight concrete consisting of a mixture of Portland cement, blended Portland cement, cement substitutes, fine aggregate, coarse aggregate, water and admixtures when required or permitted producing the following properties:
   1. Compressive Strength: 4,000 psi (min) at 28 days.
   2. Air Content: 5.5% to 8.0%
   3. Slump: 0 to 4 inches or the slump in the approved mix design.
   4. Water Cement Ratio: 0.45 maximum.

B. Alkali-Silica Reactivity (ASR):
   1. The Concrete supplier is required to evaluate the fine aggregates (only) used in the production of the concrete for ASR.
   2. Submit to the Engineer ASTM C1260 Accelerated mortar bar test for ASR from the aggregate supplier.
   3. Submit to the Engineer ASTM C1293 concrete prism expansion for ASR from the aggregate supplier if available, or if necessary.
   4. Documentation may include previous testing of materials so long as material source has not changed, and test is not more than 2 years old.
   5. No ASR mitigation is required if aggregates are non-reactive where ASTM C1260 accelerated mortar bar test expansion is less than 0.10% at 14 days, or if ASTM C1293 Concrete prism expansion is less than 0.04% at 1 year.
   6. If ASTM C1260 mortar bar test results is more than 0.10% expansion at 14 days, ASTM C1293 concrete prism test is required to be performed before aggregates can be used.
   7. ASR mitigation is required if aggregates are found to be moderately reactive where ASTM C1293 Concrete prism expansion is equal to or greater than 0.04%, but less than 0.12% at 1 year.
   8. Aggregates will not be accepted if ASTM C1293 Concrete prism expansion is equal to or greater than 0.12% at 1 year.

C. Mitigation Methods for Moderately Reactive Aggregates:
   1. In accordance with DOT approved Specifications.
   2. Use low Alkali Cements:
      a. Submit mill test report data and calculations for Cement and Fly ash.
      b. Maximum Alkali content of cementitious materials (cement and fly ash) (Na2Oe) (Na2O equivalent) ≤ 3.5 lbs/cyd.
      c. Maximum Alkali content in cement (Na2Oe) (Na2O equivalent) ≤ 0.7%.
      d. Maximum lime CaO in Fly ash ≤ 20%.
      e. Minimum Silica in Fly ash SiO2 ≥ 35%.
      f. Total oxides in Fly ash (SiO2 + Al2O3 + Fe2O3) ≥ 60%.
   3. Demonstrate the effectiveness of the proposed mix combination to resist the potential for excessive expansion caused by ASR using current and historic data:
      a. ASTM C1567 (14 day test) using both coarse and fine aggregate and all cementitious materials.
      b. Mortar bars constructed of cementitious materials and coarse and fine aggregates must produce an expansion of less than 0.10%.

2.3 FORM WORK

A. Provide necessary form work to provide concrete dimensions indicated on the Drawings ±1/2 inch.
   1. Forms to be straight and true, minimum 1 5/8-inch thick wood, full depth of concrete or steel forms.
   2. All curved radius pours to be smooth deflectable steel.

2.4 CONTRACTION JOINTS

A. Provide necessary contraction joints to control random cracking with sawcut or hand-troweled joint.
   1. Depth: 1/4 slab thickness minimum, or as indicated on the Drawings.
   2. Spacing: Maximum of 10 feet for 4-inch slabs, maximum of 12 feet for 5-inch and 6-inch slabs, maximum of 15 feet for 7-inch and greater slabs.
   3. Cut in location as indicated on the Drawings.
   4. Keep panels as square as possible with length not more than 25% greater than width.

2.5 ISOLATION (EXPANSION) JOINTS

A. Joint fiber shall be preformed, composed of either blended, bonded flexible and waterproof fiber meeting the requirements of AASHTO M213 or polyvinyl chloride with fabric strand.

B. Reinforcement: Proflex by Oscoda Plastics; or approved equal.

C. Full depth of concrete.

2.6 SEALANTS

A. Joint sealant to be gray elastomeric silicone or polyurethane sealant conforming to ASTM 920: Sonoborn SL-2; or equal.

PART 3 - EXECUTION

3.1 GRADING

A. Provide smooth base of granular material compacted to 95% of its maximum density in accordance with ASTM D1557.

B. Proof of Test Rolling: Field testing of the uniformity and stability of the subgrade, subbase or base:
   1. Loaded dump truck or other approved equipment.
   2. Areas shown or as designated by Engineer or field representative.
   3. In presence of Engineer or field representative.
   4. Repair/undercut failed areas as directed.

3.2 INSTALLATION

A. Weather and Temperature Limitations:
   1. Do not place concrete when the temperature of the air is at or expected to drop below 40 degrees F for at least 7 days after placing.
   2. Do not place concrete if portions of the base, subbase, or subgrade layer are frozen, or if the grade exhibits poor stability from excessive moisture levels.
   3. Do not place concrete when the temperature of the air is above or expected to exceed 85 degrees F for at least 7 days after placing.

B. Cold Weather Concrete Operations:
   1. Comply with the recommendations of ACI 306R.
   2. Recommended Protective Measures:
      a. Heating materials.
      b. Providing insulating blankets and windbreaks.

c. Heated enclosures.
d. Advise Engineer of planned protective measures.
e. Straw or similar materials are not allowed.

3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete on frozen subgrade.

C. Hot Weather Concrete Operations:
1. Comply with the recommendations of ACI 305R.
2. Recommended Protective Measures:
a. Cooling materials.
b. Concrete placement during cooler hours of the day.
c. Providing shading and windbreaks.
3. Advise Engineer of planned protective measures.

D. Preparation of Base:
1. Excavate to the required depth and to a width that will permit forming.
2. Remove unsuitable material below the required depth and replace with sound earth.
3. Shape and compact the base to conform to the section indicated on the Drawings.

E. Forms:
1. Use fixed forms.
2. Apply form releasing agent to prevent concrete from bonding to forms.
3. Provide straight, full depth forms free of warp and strong enough to resist springing during concrete placement.
4. Firmly stake fixed forms to prohibit movement.

F. Placing Concrete:
1. Place all concrete in accordance with ACI 304R and ACI 304.2R.
2. Moisten base before placing concrete.
3. Place concrete and consolidate, including along the faces of the forms, before finishing.
4. Place and finish in a continuous operation.
5. When replacing gutters along with concrete walk ramps, construct the gutter to the same dimensions and profile and use the same reinforcement pattern as the existing gutter.

G. Joints:
1. General: Comply with ACI 318-6.3, 6.4, and ACI 301, Section 6.
a. Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete.
b. Construct transverse joints at right angles to the centerline, unless otherwise indicated.
2. Weakened-Plane (Contraction) Joints:
a. Provide weakened-plane (contraction) joints, sectioning concrete into areas
1) As indicated on the Drawings.
2) 24 to 36 times the thickness of the slab if not indicated on the Drawings.
b. Contraction joints for curbs shall be provided at maximum 10 foot intervals and maximum 15-foot spacing for slabs, unless indicated otherwise.
c. Construct weakened plane joints for a depth equal to at least 1/4 concrete thickness, as follows:
1) Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
2) Sawed Joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
3. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such placements terminate at expansion joints.
4. Expansion Joints:
a. Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.
b. Locate expansion joints at 100 feet on center along linear lengths of curb and walks, and at points of radii of curbs unless otherwise indicated.

5. Extend joint fillers full width and depth of joint, and not less than 1/2 inch or more than 1 inch below finished surface for joint sealant.
6. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.

H. Reinforcing:
1. Install reinforcing as indicated on the Drawings.
2. Install in accordance with CRSI for placing reinforcing bars and Manual of Standard Practice.

I. Epoxy Coating:
1. Minimum 6 mils thick and uniform.
2. Coat reinforcement after fabrication.
3. Repair damage to epoxy coating in accordance with:
   a. ASTM A775.
   b. Epoxy-coating Manufacturer's recommendations.

J. Backfilling:
1. After the concrete has gained sufficient strength, remove fixed forms and backfill with sound earth.
2. Compact and level the backfill 1-inch below the surface of the concrete.

3.3 CONCRETE FINISHING AND TEXTURING

A. After striking-off and consolidating concrete, smooth surface by screening and floating. Use hand method only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture in accordance with the final cross section indicated on the Drawings.

B. After floating, test surface for trueness with a 10 foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs, and formed joints with an edging tool, and round to 1/2 inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

D. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
1. Exterior slabs and concrete pavement types shall have a non-slip finish by scoring the surface with a heavy broom or damp burlap, longitudinally to the line of traffic across the entire width of the newly placed concrete.
2. Repeat operation if required to provide a line texture acceptable to the Engineer.

E. Do not remove forms for 24 hours after concrete has been placed.
1. After form removal, clean ends of joints and point-up any minor honeycombed areas.
2. Remove and replace areas or sections with major defects, as directed by the Engineer.

3.4 CURING

A. General:
1. As soon as possible, after texturing operations have been completed and after the free water has left the surface, coat the concrete walk surface and sides of slip-formed concrete walks with a uniform layer of membrane curing compound.
2. Apply 1 coat of curing compound on non-grooved surfaces and 2 coats on grooved surfaces.
3. Apply not less than 1 gallon per 25 square yards of concrete for each application.
4. Apply the second coat after the first has dried sufficiently but do not exceed 2 hours between coats.
5. Keep the compound thoroughly mixed according to the Manufacturer’s recommendations.
6. Do not thin curing compound.
7. Reapply curing compound immediately to surfaces damaged by rain, joint sawing, foot traffic or other activities.
8. If fixed forms are removed during the curing period, coat the entire area of the sides of the concrete walk with curing compound immediately after removal of forms.

B. These requirements are minimum requirements only.

C. Repair or replacement of concrete showing damage due to inadequate curing is required.

D. All costs associated with this corrective work will be borne by the Contractor.

3.5 PROTECTION

A. Protect the concrete from damage until acceptance of the Work.

B. Protect the concrete from freezing until the concrete has attained a compressive strength of at least 1000 psi.

C. Maintain surface as clean by removing surface stains and spillage of materials as they occur.

D. Sweep concrete and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

3.6 DEFECTIVE WORK

A. The following list of deficiencies are considered defective work if found within 1 year of installation. Removal or replacement by the Contractor at no cost to the Owner is required:
   1. Difference in elevation between panels of 1/4-inch or greater.
   2. Cracks of any lengths that are 1/8-inch wide or wider.
   3. Surface spalling covering in excess of 20% of the area of any 1 panel.
   4. A hole that is 1/2-inch or greater in depth and 2 inches or greater in diameter.
   5. Residual splatter that is 1/2-inch or higher and attached to a panel.
   6. Elevation difference of 1/2-inch in 10 feet caused by settling, that has not caused an elevation difference between panels.
   7. Multiple hairline cracking.
   8. Footprints, bike tire tracks, animal tracks, or the like, created while concrete was not cured.
   9. ASR cracking or potholing.

3.7 CLEAN-UP

A. For duration of work, Contractor is to maintain work area free of waste material, debris, and the like.

B. Provide onsite containers as necessary for work of this Section.

C. Remove upon completion all excess material, debris, and equipment.

END OF SECTION 32 13 13

SECTION 32 13 14 – CONCRETE WALKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of concrete walks.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Publications:
      a. A820 – Steel Fibers for Fiber Reinforced Concrete.
      b. C33 – Specification for Concrete Aggregates.
      c. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      d. C94 – Specification for Ready-Mixed Concrete.
      e. C136 – Sieve Analysis of Fine and Coarse Aggregates.
      f. C150 – Specification for Portland Cement.
      g. C260 – Specification for Air-Entraining Admixtures for Concrete.
      h. C309 – Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      i. C330 – Specification for Lightweight Aggregates for Structural Concrete.
      j. C494 – Specification for Chemical Admixtures for Concrete.
      k. C595 – Specification for Blended Hydraulic Cements.
      l. C618 – Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
   2. ACI – American Concrete Institute:
      a. 117 – Standard Tolerances for Concrete Construction and Materials.
      b. 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
      c. 302.1R – Guide for Concrete Floor and Slab Construction.
      d. 303R – Guide to Cast-In-Place Architectural Concrete Practice.
      e. 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
      f. 305R – Hot Weather Concreting.
      g. 306R – Cold Weather Concreting.
      h. 309R – Guide for Consolidation of Concrete.
   3. Americans with Disabilities Act (ADA).

1.4 SUBMITTALS

A. Action Submittals:
   1. Provide mix design for concrete to be supplied.
      a. Include quantities and sources of all aggregates, cement, cementitious materials, and admixtures to be used.
      b. Submitted from a state DOT certified testing laboratory regularly engaged in designing and testing concrete for exterior paving.
      c. Use test results for mix design from within the past 12 months.
   2. Product Data: Submit Manufacturer's product data with application and installation instructions for admixtures, curing compounds, expansion joint fillers and sealants.
   3. Alkali-Silica Reactivity (ASR):
      a. Submit to Engineer ASTM C1260 Accelerated mortar bar test, and ASTM C1293 Concrete prism expansion for ASR from aggregate supplier.

b. Documentation may include previous testing (within previous 2 years) of materials and sources intended for use.
c. Documentation may include previous testing (within previous 2 years) from other projects or records provided by the material suppliers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement:
1. Portland cement, ASTM C150, Type I or I/II.
2. Portland Limestone Cement: ASTM C595, Type 1L.
3. Do not use different types of cement, different manufacturers of cement, or different degrees of fineness.

B. Cementitious Materials or Cement Substitutes:
1. Fly Ash: ASTM C618, Class C or F.
2. Ground Granulated Blast Furnace Slag (GGBFS):
a. ASTM C989 Grade 100 minimum.
b. Use only as a blending material with Type I or Type IA Portland cement.
3. Silica Fume, Dry-Densified:
a. ASTM C1240.
b. Use only as a blending material with Type I or Type IA Portland cement.
4. Reduce the cement quantity up to a maximum of 25% for fly ash substitution or up to 40% for GGBFS substitution.
5. Fly ash or GGBFS weight additions must equal the weight of the cement reduction.
6. For concrete containing Portland cement, fly ash and GGBFS in the same mix design, reduce the cement quantity up to 40%, with the maximum fly ash quantity not exceeding 15%.

C. Aggregates:
1. Grade aggregates according to procedures of ASTM C136, Class M, Exposure 4.
2. Coarse Aggregates: ASTM C33-5S, Number 57 (1-inch), crushed limestone.
3. Fine Aggregate: ASTM C33.
4. Test all aggregates for alkali-silica reactivity and provide mitigation method, if required.

D. Water: Clean, fresh and potable.

E. Admixtures:
1. General:
a. No admixture shall contain more than 0.1% water soluble chloride ions by mass of cementitious material.
b. No admixture shall contain calcium chloride.
2. Air-Entraining:
a. Comply with ASTM C260.
b. Daravair series or Darex series, by W.R. Grace & Company; Micro Air, by BASF Admixtures, Inc.; or equal.

F. Curing Agents:
1. Curing agents shall comply with ASTM C309.
2. Provide approved products by Symons Corporation, W.R. Meadows, L & M Chemical, Master Builders or Dayton-Superior which are compatible with floor coatings or toppings specified.
3. Compounds:
a. Curing:
1) 1600 White by W.R. Meadows.
2) Day-Chem Rez Cure (J-11-W) by Dayton Superior.
3) Resi-Chem Clear Cure by Symons.
4) Confilm by Master Builders.
5) L & M Cure by L & M Chemical.

2.2 CONCRETE MIX DESIGN

A. Design mix to project normal-weight concrete consisting of Portland cement aggregate, air-entrained add mixture and water producing the following properties:
   1. Compressive Strength: 3,500 psi (min) at 28 days.
   2. Air Content: 5.5% to 8.0%
   3. Slump: 0 to 3 inches unless mid-range water reducer is used then slump may 6 inches Water Cement Ratio: 0.5 maximum.

B. Alkali-Silica Reactivity (ASR):
   1. The Concrete supplier is required to evaluate the fine aggregates (only) used in the production of the concrete for ASR.
   2. Submit to the Engineer ASTM C1260 Accelerated mortar bar test for ASR from the aggregate supplier.
   3. Submit to the Engineer ASTM C1293 concrete prism expansion for ASR from the aggregate supplier if available, or if necessary.
   4. Documentation may include previous testing of materials so long as material source has not changed, and test is not more than 2 years old.
   5. No ASR mitigation is required if aggregates are non-reactive where ASTM C1260 accelerated mortar bar test expansion is less than 0.10% at 14 days, or if ASTM C1293 Concrete prism expansion is less than 0.04% at 1 year.
   6. If ASTM C1260 mortar bar test results is more than 0.10% expansion at 14 days, ASTM C1293 concrete prism test is required to be performed before aggregates can be used.
   7. ASR mitigation is required if aggregates are found to be moderately reactive where ASTM C1293 Concrete prism expansion is equal to or greater than 0.04%, but less than 0.12% at 1 year.
   8. Aggregates will not be accepted if ASTM C1293 Concrete prism expansion is equal to or greater than 0.12% at 1 year.

C. Mitigation Methods for Moderately Reactive Aggregates:
   1. In accordance with DOT approved Specifications.
   2. Use low Alkali Cements:
      a. Submit mill test report data and calculations for Cement and Fly ash.
      b. Maximum Alkali content of cementitious materials (cement and fly ash) (Na2Oe) (Na2O equivalent) ≤ 3.5 lbs/cyd.
      c. Maximum Alkali content in cement (Na2Oe) (Na2O equivalent) ≤ 0.7%.
      d. Maximum lime CaO in Fly ash ≤ 20%.
      e. Minimum Silica in Fly ash SiO2 ≥ 35%.
      f. Total oxides in Fly ash (SiO2 + Al2O3 + Fe2O3) ≥ 60%.
   3. Demonstrate the effectiveness of the proposed mix combination to resist the potential for excessive expansion caused by ASR using current and historic data:
      a. ASTM C1567 (14 day test) using both coarse and fine aggregate and all cementitious materials.
      b. Mortar bars constructed of cementitious materials and coarse and fine aggregates must produce an expansion of less than 0.10%.

2.3 DETECTABLE/TACTILE WARNING SURFACES

A. Furnish and install tactile surface plate into uncured concrete cement.
   1. In accordance with most current Americans With Disabilities Act (ADA).
   2. Materials:
      a. Vitrified Polymer Composite (VPC), cast-in-place surface tile.
      b. Cast iron warning plate.
   3. Manufacturers:
      a. VFC: Armor Tile, ADA Solutions.
      b. East Jordan Iron Works, Neenah Foundry Company.
   4. Color:
      a. Brick Red (Color No. 22144).
   5. Plates must be radial to match curb radius when indicated on the Drawings.

2.4 FORM WORK

A. Provide necessary form work to provide concrete dimensions indicated on the Drawings ±1/2 inch.
   1. Forms to be straight and true, minimum 1 5/8-inch thick wood, full depth of concrete or steel forms.
   2. All curved radius pours to be smooth deflectable steel.

2.5 EXPANSION JOINTS

A. Joint fiber shall be pre formed, composed of either blended, bonded flexible and waterproof fiber meeting the requirements of AASHTO M213 or polyvinyl chloride with fabric strand.

B. Reinforcement: Proflex by Oscoda Plastics; or approved equal.

C. Full depth of concrete.

2.6 SEALANTS

A. Joint sealant to be gray elastomeric silicone or polyurethane sealant conforming to ASTM 920: Sonoborn SL-2; or equal.

PART 3 - EXECUTION

3.1 GRADING

A. Provide smooth base of granular material compacted to 95% of its maximum density in accordance with ASTM D1557.

3.2 INSTALLATION

A. Weather and Temperature Limitations:
   1. Do not place concrete when the temperature of the air is at or expected to drop below 40 degrees F for at least 7 days after placing.
   2. Do not place concrete if portions of the base, subbase, or subgrade layer are frozen, or if the grade exhibits poor stability from excessive moisture levels.
   3. Do not place concrete when the temperature of the air is above or expected to exceed 85 degrees F for at least 7 days after placing.

B. Cold Weather Concrete Operations:
   1. Comply with the recommendations of ACI 306R.
   2. Recommended Protective Measures:
      a. Heating materials.
      b. Providing insulating blankets and windbreaks.
      c. Heated enclosures.
   3. Advise Engineer of planned protective measures.
   4. Straw or similar materials shall not be allowed.
   5. Do not use frozen materials or materials containing ice or snow.
   6. Do not place concrete on frozen subgrade.

C. Hot Weather Concrete Operations:
   1. Comply with the recommendations of ACI 305R.
   2. Recommended Protective Measures:
      a. Cooling materials.
      b. Concrete placement during cooler hours of the day.
      c. Providing shading and windbreaks.
   3. Advise Engineer of planned protective measures.

D. Slope:
   1. All walks should have a cross slope of a minimum 1% and maximum 2% sloped toward a curb or lower elevation.
   2. No walks should exceed 5% longitudinal slope.

E. Preparation of Base:
   1. Excavate to the required depth and to a width that will permit forming.
   2. Remove unsuitable material below the required depth and replace with sound earth.
   3. Shape and compact the base to conform to the section indicated on the Drawings.

F. Forms:
   1. Use fixed forms.
   2. Apply form releasing agent to prevent concrete from bonding to forms.
   3. Provide straight, full depth forms free of warp and strong enough to resist springing during concrete placement.
   4. Firmly stake fixed forms to prohibit movement.

G. Reinforcing: Reinforce all concrete walks with welded wire fabric pulled up 2 inches into concrete.

H. Placing and Finishing Concrete:
   1. Place all concrete in accordance with ACI 304R and ACI 304.2R.
   2. Moisten base before placing concrete.
   3. Place concrete and consolidate, including along the faces of the forms, before finishing.
   4. Place and finish in a continuous operation.
   5. When replacing gutters along with concrete walk ramps, construct the gutter to the same dimensions and profile and use the same reinforcement pattern as the existing gutter.
   6. Float the surface just enough to produce a smooth surface free from irregularities.
   7. Round edges and joints with an approved finishing tool.
   8. Broom finish concrete walks and ramps by drawing a fine-hair broom across the concrete surface, perpendicular to the line of traffic. Repeat operation if required to provide a fine line texture acceptable to the Engineer.

I. Joints:
   1. General: Comply with ACI 318-6.3, 6.4, and ACI 301, Section 6. Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.
   2. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as indicated on the Drawings. Contraction joints for curbs shall be provided at 10 foot intervals and 20 foot spacing for slabs, unless shown otherwise. Construct weakened plane joints for a depth equal to at least 1/4 concrete thickness, as follows:
      a. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
      b. Sawed Joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
   3. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such placements terminate at expansion joints.
   4. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated. Locate expansion joints at 100 feet on center along linear lengths of curb and walks, and at points of radii of curbs unless otherwise indicated.
   5. Extend joint fillers full width and depth of joint, and not less than 1/2 inch or more than 1 inch below finished surface for joint sealant.
   6. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.

J. Thickness: Except as otherwise specified or indicated on the Drawings, provide a minimum thickness of 4 inches.

K. Where walkways cross driveways, provide a minimum thickness of 6 inches.

L. Ramps:
   1. As indicated on the Drawings.
   2. No ramp shall exceed 1:12 slope.
   3. Place detectable warning domed plates in fresh concrete in accordance with Manufacturer's instructions on ramp surface.
   4. ADA domes to be 24 inches wide, full width of ramp.

M. Backfilling:
   1. After the concrete has gained sufficient strength, remove fixed forms and backfill with sound earth.
   2. Compact and level the backfill 1-inch below the surface of the concrete.

3.3 CONCRETE FINISHING

A. After striking-off and consolidating concrete, smooth surface by screening and floating. Use hand method only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a 10 foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs, and formed joints with an edging tool, and round to 1/2 inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

D. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
   1. Exterior slabs, sidewalks, flow channels, flumes, curbs, and other similar concrete pavement types shall have a non-slip finish by scoring the surface with a fine-hair broom, perpendicular to the line of traffic. Repeat operation if required to provide a fine line texture acceptable to the Engineer.
   2. Retaining walls, wing walls, light pole bases, and other surfaces exposed to view upon completion of work shall be given a rubbed finish as specified below:
      a. Immediately upon removal of the forms, the surfaces to be rubbed shall be pointed up, thoroughly wetted and then rubbed with a No. 20 carborundum brick and water so as to produce a true, even, and smooth surface. When necessary to fill pinholes, and upon areas which have been reconstructed, rubbing shall be done by carborundum brick and a thin cement grout composed of 1 part of cement and 2 parts of fine washed silicone sand, all of which shall pass a No. 20 sieve. The surfaces finished with grout shall be carefully scraped with a steel edge so as to remove all surplus grout, after which it shall be given a final rub with a wood float until all skin and form marks shall be removed. No "wash" composed of cement and water, or cement, sand and water shall be used in this process.

E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Engineer.

3.4 CURING

A. General:
   1. After texturing operations have been completed and after the free water has left the surface, coat the concrete walk surface and sides of slip-formed concrete walks with a uniform layer of membrane curing compound.
   2. Apply 1 coat of curing compound on non-grooved (broomed) surfaces and 2 coats on grooved (raked) surfaces.
   3. Apply not less than 1 gallon per 25 square yards of concrete for each application.
   4. Apply the second coat after the first has dried sufficiently but do not exceed 2 hours between coats.
   5. Keep the compound thoroughly mixed according to the Manufacturer's recommendations.
   6. Do not thin curing compound.

7. Reapply curing compound immediately to surfaces damaged by rain, joint sawing, foot traffic or other activities.
8. If fixed forms are removed during the curing period, coat the entire area of the sides of the concrete walk with curing compound immediately after removal of forms.

B. These requirements are minimum requirements only. Repair or replacement of concrete showing damage due to inadequate curing is required. All costs associated with this corrective work will be borne by the Contractor.

3.5 ADA TRUNCATED DOMES

A. Prior to installation, review mix design with concrete supplier and installer to ensure concrete has proper slump and will not set too rapidly to allow for proper installation.

B. Install system in accordance with Manufacturer's specifications and recommendations. Dome panels to be perpendicular and parallel with curb with no gaps between panels. Panels must be level and flush with adjacent concrete walk. Installation must be acceptable to Engineer or removed and replaced at Contractor's expense.

C. Install top of domes flush with top of adjacent concrete along top and sides of plates. Install bottom of domes flush with concrete at lower end of plates.

3.6 PROTECTION

A. Protect the walks from damage until acceptance of the Work.

B. Protect the concrete from freezing until the concrete has attained a compressive strength of at least 1000 psi.

C. Maintain walks as clean as practical by removing surface stains and spillage of materials as they occur.

D. Sweep concrete walks and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

3.7 DEFECTIVE WORK

A. The following list of deficiencies shall be considered defective work and shall be replaced by the Contractor at no cost to the Owner:
1. Difference in elevation between panels of 1/2-inch or greater.
2. Cracks of any length that are 1/8-inch wide or wider.
3. Surface spalling covering in excess of 20% of the area of any 1 panel.
4. A hole that is 1/2-inch or greater in depth and 2 inches or greater in diameter.
5. Residual splatter that is 1/2-inch or higher and attached to a panel.
6. Elevation difference of 3/4-inch in 10 feet caused by settling, that has not caused an elevation difference between panels.
7. Multiple hairline cracking.
8. Footprints, bike tire tracks, animal tracks, or the like, created while concrete was not cured.
9. Improperly install tactile warning surface.
10. ASR cracking or potholing.

3.8 CLEAN-UP

A. For duration of work, Contractor is to maintain work area free of waste material, debris, and the like.
1. Contractor shall provide on-site containers as necessary for work of this Section. Locate as directed by Engineer.

B. Upon completion and when directed by Engineer, Contractor shall remove all excess material, debris, and equipment occasioned by the work.

END OF SECTION 32 13 14

SECTION 321440.15 – PORCELAIN PAVER PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of porcelain paving is shown on drawings and in schedules.

B. Types of porcelain paving and applications include the following:

1. Latex-modified Portland Cement mortar applications

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical data for each manufactured product, including certification that each product complies with specified requirements.

B. Samples for Verification Purposes: Submit samples made up of actual porcelain, color and texture required. Include in each set of samples the full range of exposed color and texture to be expected in the completed work.

C. Submit sample of colored grout required.

D. Submit complete numbered shop drawings (setting drawings) of all porcelain work.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: Engage an Installer who has successfully completed within the last three years at least three porcelain paving applications similar in type and size to that of this project and who will assign masons from these earlier applications to this project, of which one will serve as lead mason.

B. Field-Constructed Mockup: Prior to installation of porcelain paving, fabricate mockup using materials, pattern and joint treatment indicated for project work, including special features for expansion joints and contiguous work. Build mockup in form of panel at the site, in location as directed, of full thickness and approximately 4'X6' (with radious show on plans). Provide range of color, texture and workmanship to be expected in the completed work. Obtain Owner's Representative and Landscape Architect's acceptance of visual qualities of mockup before start of porcelain paving work. Retain mockup during construction as a standard for judging completed porcelain paving work. Do not move or destroy mockup until work is completed.

C. Do not change source of brands for porcelain, setting materials, or grout during progress of work.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Protect porcelain pavers during storage and construction against wetting by rain, snow or ground water and against soilage or intermixture with earth or other types of materials.

B. Protect grout and mortar materials from deterioration by moisture and temperature. Store in a dry location or in waterproof container. Keep containers tightly closed and away from open flame. Protect liquid components from freezing.

1.6 PROJECT CONDITIONS:

A. Cold Weather Protection:

1. Frozen Materials: Do not use frozen materials or materials mixed or coated with ice or frost.
2. Frozen Work: Do not build on frozen subgrade or setting beds. Remove and replace porcelain paver work damaged by frost or freezing.

B. Weather Limitations for Latex-Modified Portland Cement Mortar Applications: Protect porcelain paving work against freezing when atmospheric temperature is 40 degrees F (4 degrees C) and falling. Heat materials and provide temporary protection of completed portions of porcelain paving work. Comply with requirements of International Masonry All-Weather Council's "Guide Specification for Cold-Weather Masonry Construction", Section 04200, Article 3.

C. Hot Weather Requirements: Protect porcelain paving work in hot weather to prevent excessive evaporation of setting beds and grout. Provide artificial shade, wind breaks and use cooled materials, as required.

PART 2 - PRODUCTS

2.1 PORCELAIN PAVERS:

A. Manufactured By: Ergon Engineered Stone

B. Material: Bocciardato R11 Rectified

C. Size: 20mm thick, 18”x36” rectangular paver

D. Color: Ivory

E. Pattern: Per plans

2.2 SETTING MATERIALS:

A. Latex-Modified Portland Cement Applications:

1. Aggregate: ASTM C-144 with a fineness module of 2.25 plus-or-minus 0.10.
2. Portland Cement: ASTM C-150, Type I
3. Liquid Admixture for Setting Bed, Bond Coat and Grout: Acrylic resin or styrene butadiene rubber formulations in factory-prediluted or concentrated form; designated by manufacturer for use with thick-bed mortar, bond coat and grout applications; and producing mortar and grout with a compressive strength of 3000 psi, bond strength of 214 psi, and no loss in strength when exposed to ozone for 200 hours at an ozone concentration of 200 pphm as determined by independent testing laboratories using manufacturer's designated test methods.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Laticrete 3701 for setting bed and grout, Laticrete 254 Platinum for bond coat; Laticrete International Inc.
2) Hydroment Multipurpose Acrylic Latex Additive; Upco Division, Emhart Corp.

4. Setting Bed Reinforcement: Galvanized welded wire fabric, 2" x 2" - WO.3 x WO.3 (16 AWS gage or 0.0625" diam.); comply with ASTM A-185 and ASTM A-82, except for minimum wire size.
5. Water: Clean and portable.
6. Colored Pigmented Grout: Manufacturer's standard factory-prepackaged mixture of cement, fine aggregate and color-fast pigments formulated for mixing with liquid latex admixture; provide color as selected by Owner's Representative and Landscape Architect from manufacturer's standard colors.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) Laticrete Floor Grout and Joint Filler: Laticrete International Inc.
      2) Hydroment Grout: Upco Division, Emhart Corp.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Installer must examine the areas and conditions under which porcelain paving is to be installed and notify the Owner's Representative and Landscape Architect in writing of conditions detrimental to the proper and timely completion of work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION, GENERAL:

A. Do not use porcelain pavers with chips, cracks, voids, discoloration or other defects which might be visible or cause staining in finished work.

B. Cut porcelain pavers with motor-driven saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting.

C. Set porcelain pavers in patterns shown and with uniform joints of width and alignment indicated.

D. Tolerances: Do not exceed a tolerance of 1/8" in 10' from level or slope as indicated for finished surface of paving.

E. Install joint filler where sealant type joints are shown. For joint filler and sealant materials and for their installation requirements, refer to Section 079200 – Joint Sealants.

3.3 LATEX-MODIFIED PORTLAND CEMENT APPLICATIONS:

A. Clean concrete subbase to remove dirt, dust, debris and loose particles.

B. Saturate-concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

C. Apply slush coat of cement grout over surface of concrete subbase about 15 minutes prior to placing setting bed. Limit area of slush coat to avoid its drying out prior to placing setting bed.

Mix slush coat to a consistency similar to that of thick cream and consisting of either neat cement and water or cement, sand and water. Do not exceed 1/16" thickness for cement slush coat.

D. Mix setting bed in proportions of one bag of Portland Cement to 3 cu.ft. of sand (measured in damp loose condition) to quantity of liquid admixture recommended by admixture manufacturer and necessary to produce stiff mixture with a moist surface when setting bed is ready to receive porcelain.

E. Spread and screed setting bed to uniform thickness at subgrade elevations required for accurate setting of porcelain pavers to finished grades indicated. Mix and place only the amount which can be covered with porcelain prior to initial set. Cut back, bevel edge, remove and discard setting pavers bed material which has reached initial set prior to placing porcelain.

1. Place setting bed reinforcement approximately in center of setting bed.

F. Wet porcelain pavers several hours before laying unless their initial rate of absorption (suction) when subjected to testing by method described in Section 9 of ASTM C-67 is less than 3/4 oz. per 30 sq. in. of immersed area. Do not lay porcelain pavers with free moisture on the surfaces.

G. Place porcelain pavers before initial set of cement occurs. Immediately prior to placing porcelain on green or wet setting bed, apply uniform 1/16" thick slurry bond coat to bed with a flat trowel using mix of cement and liquid bond coat admixture proportioned according to admixture manufacturer's recommendations. Apply skim coat of same material to back of each porcelain paver just prior to placing it on bed.

H. Tamp porcelain pavers to level and embed them in setting bed. Embed and level each porcelain paver in single operation, prior to initial set of cement bed; do not return to areas already set and disturb porcelain for leveling purposes.

I. Grout joints as soon as possible after initial set of setting bed. Force grout into joints, taking care not to smear grout on adjoining porcelain and other surfaces. After initial set of grout, finish joints by tooling to produce a very slightly concave polished joint, free from drying cracks.

1. Mix grout consisting of factory-prepared color pigmented grout and liquid admixture in proportions recommended by grout manufacturer.

J. Cure grout by maintaining in a damp condition for seven days, except as otherwise recommended by grout admixture manufacturer.

3.4 REPAIR, POINTING, CLEANING AND PROTECTION:

A. Remove and replace porcelain pavers which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point-up joints as sealant type joints to provide a neat, uniform appearance, properly prepared for application of sealant.

C. Cleaning: Remove excess mortar from exposed porcelain surfaces, wash and scrub clean.

D. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures porcelain paving work being without damage or deterioration at time of substantial completion.

END OF SECTION 321440.15

SECTION 32 14 50 - PORCELAIN UNIT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Porcelain unit pavers.

B. Paver Pedestals

1.2 RELATED REQUIREMENTS

A. Section 03 31 00 - Structural Concrete: Cast-In-Place concrete base for porcelain pavers.

B. Section 33 40 00 – Storm Drainage Utilities: Trench drains installed below porcelain pavers.

1.3 SUBMITTALS

A. Product Data for Porcelain Pavers and Paver Pedestals: Characteristics, dimensions, and special shapes.

B. Samples: Submit one sample of each porcelain paver type. Sample will be retained at Architect's office and not returned to Contractor.

C. Installer's qualification statement.

D. Maintenance contract.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with minimum five years of documented experience.

B. Do not change source of brands for porcelain pavers or pedestals during progress of work.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Protect porcelain pavers during storage and construction against wetting by rain, snow or ground water and against soilage or intermixture with earth or other types of materials.

PART 2 PRODUCTS

2.1 PORCELAIN UNIT PAVERS

A. Pavers: Solid, complying with ANSI A137.1.
   1. Comply with local wind load resistance requirements of ASCE 7.
   2. Size: As indicated on Drawings.
   3. Thickness: As indicated on Drawings.
   4. Color: As indicated on Drawings..
   5. Finish: As indicated on Drawings.

6. Products:
   a. Basis of Design: Ergon Engineered Stone, Elegance Pro.
   b. Other Acceptable Manufacturer's: As reviewed and accepted by Architect.

B. Paver Pedestals: Adjustable stand of multiple high impact copolymer polypropylene components to level and adjust height of pavers using 4-3/16 inches diameter SDR-35 PVC pipe, with maximum static load of 2,000 lb per pedestal.
   1. Comply with local wind load resistance requirements of ASCE 7.
   2. Self-Ignition Temperature: Provide plastic pedestal components with self-ignition temperature greater than 650 degrees F in accordance with ASTM D1929 test method.
   3. Pedestal Height: Within 1/2 inch to 2-1/4 inches, without use of PVC pipe in pedestal system.
   4. Pedestal Height: Within 2-1/4 inches to 36 inches, with use of PVC pipe in pedestal system.
   5. Products:
      a. Basis of Design: Tile Tech Inc; Hybrid Pedestal System.
      b. Other Acceptable Manufacturer's: As reviewed and accepted by Architect.

2.2 ACCESSORIES

A. Cleaning Solution: Type recommended by paver manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate is level, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this section.

B. Verify gradients and elevations of concrete base.

C. Installer must examine the areas and conditions under which porcelain paving is to be installed and notify the General Contractor8 in writing of conditions detrimental to the proper and timely completion of work. do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION OF PORCELAIN UNIT PAVERS

A. Do not use porcelain pavers with chips, cracks, voids, discoloration or other defects which might be visible or cause staining in finished work.

B. Cut porcelain pavers with motor-driven saw equipment to provide clean, sharp, unchipped edges. cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting.

C. Place paver units in perpendicular running bond pattern as indicated on Drawings from straight reference line, creating staggered joints.

D. Place half units or special-shaped units at edges and interruptions. Maintain evenly spaced joints.

3.3 INSTALLATION OF PAVER PEDESTIALS

A. Install paver pedestals according to manufacturer's written instructions.

B. Install paver pedestals and leveling shims as required, in accordance with Manufacturer’s recommendations and architectural layout.

3.4 INSTALLATION OF CONCRETE BASE

A. As indicated in Division 03, Structural Concrete.

3.5 INSTALLATION OF TRENCH DRAIN

A. As indicated in Division 33, Storm Drainage Utilities.

3.6 TOLERANCES

A. Do not exceed a tolerance of 1/4" in 10' from level or slope as indicated for finished surface of paving.

B. Lippage: Maximum 1/8-inch difference in height between adjacent pavers.

3.7 FIELD QUALITY CONTROL

A. Ensure final surface elevations comply with drawings.

3.8 CLEANING

A. Clean soiled surfaces using cleaning solution. Do not harm pavers, or adjacent surfaces.

B. Rinse surfaces with clean water.

C. Sweep paving surfaces and dispose of excess material.

3.9 PROTECTION

A. Do not permit traffic over unprotected paver surface.

B. Protect paver surface from construction traffic with sheets of plywood or OSB.

3.10 MAINTENANCE

A. Provide separate maintenance contract for service and maintenance of pavers for 3 years from date of project Substantial Completion.

END OF SECTION

SECTION 32 16 13 – CONCRETE CURBS AND GUTTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of concrete curbs and gutters.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Publications:
      a. A820 – Steel Fibers for Fiber Reinforced Concrete.
      b. C33 – Specification for Concrete Aggregates.
      c. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      d. C94 – Specification for Ready-Mixed Concrete.
      e. C136 – Sieve Analysis of Fine and Coarse Aggregates.
      f. C150 – Specification for Portland Cement.
      g. C260 – Specification for Air-Entraining Admixtures for Concrete.
      h. C309 – Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      i. C330 – Specification for Lightweight Aggregates for Structural Concrete.
      j. C494 – Specification for Chemical Admixtures for Concrete.
      k. C595 – Specification for Blended Hydraulic Cements.
      l. C618 – Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
   2. ACI – American Concrete Institute:
      a. 117 – Standard Tolerances for Concrete Construction and Materials.
      b. 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
      c. 302.1R – Guide for Concrete Floor and Slab Construction.
      d. 303R – Guide to Cast-In-Place Architectural Concrete Practice.
      e. 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
      f. 305R – Hot Weather Concreting.
      g. 306R – Cold Weather Concreting.
      h. 309R – Guide for Consolidation of Concrete.

1.4 SUBMITTALS

A. Action Submittals: Provide mix design for concrete to be supplied.

1.5 QUALITY ASSURANCE

A. Testing: Testing will be performed in accordance with Division 01 Section "Testing Services for Buried Utilities, Roadways, and Site Projects" and the Contractor's Quality Control Plan.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement:
   1. Portland cement, ASTM C150, Type I or I/II.
   2. Portland Limestone Cement: ASTM C595, Type 1L.
   3. Do not use different types of cement, different manufacturers of cement, or different degrees of fineness.

B. Fly Ash: ASTM C618, Class C.

C. Aggregates:
   1. Grade aggregates according to procedures of ASTM C136, Class M, Exposure 4.
   2. Coarse Aggregates: ASTM C33-5S, Number 57 (1-inch), crushed limestone.
   3. Fine Aggregate: ASTM C33.

D. Water: Clean, fresh and potable.

E. Admixtures:
   1. General:
      a. No admixture shall contain more than 0.1% water soluble chloride ions by mass of cementitious material.
      b. No admixture shall contain calcium chloride.
   2. Air-Entraining:
      a. Comply with ASTM C260.
      b. Daravair series or Darex series, by W.R. Grace & Company; Micro Air, by BASF Admixtures, Inc.; or equal.

F. Curing Agents:
   1. Curing agents shall comply with ASTM C309, Type 2 white.
   2. Provide approved products by Symons Corporation, W.R. Meadows, L & M Chemical, Master Builders or Dayton-Superior:
      a. 1600 White by W.R. Meadows.
      b. Day-Chem Rez Cure (J-11-W) by Dayton Superior.
      c. Resi-Chem Clear Cure by Symons.
      d. Confilm by Master Builders.
      e. L & M Cure by L & M Chemical.

G. Concrete Reinforcement:
   1. Deformed reinforcing bars.
   2. ASTM A615, Fy = 60,000 psi.
   3. Required only when indicated on the Drawings.

2.2 CONCRETE MIX DESIGN

A. Design mix to project normal-weight concrete consisting of Portland cement aggregate, air-entrained add mixture and water producing the following properties:
   1. Compressive Strength: 3,500 psi (min) at 28 days.
   2. Air Content: 5.5% to 8,0%.
   3. Slump: 0 to 3 inches unless mid-range water reducer is used then slump may 6 inches.
   4. Water Cement Ratio: 0.5 maximum.

2.3 FORMWORK

A. Provide necessary formwork to provide concrete dimensions indicated on the Drawings ±1/2 inch.
   1. Forms to be straight and true, minimum 1 5/8-inch thick wood, full depth of concrete or steel forms.
   2. All curved radius pours to be smooth deflectable steel.

2.4 EXPANSION JOINTS

A. Joint fiber shall be preformed, composed of either blended, bonded flexible and waterproof fiber meeting the requirements of AASHTO M213 or polyvinyl chloride with fabric strand or ASTM D1751 fiber joint filler.

PART 3 - EXECUTION

3.1 GRADING

A. Provide smooth base of granular material compacted to 95% of its maximum density in accordance with ASTM D1557.

3.2 INSTALLATION

A. Weather and Temperature Limitations:
   1. Do not place concrete when the temperature of the air is at or expected to drop below 40 degrees F for at least 7 days after placing.
   2. Do not place concrete if portions of the base, subbase, or subgrade layer are frozen, or if the grade exhibits poor stability from excessive moisture levels.
   3. Do not place concrete when the temperature of the air is above or expected to exceed 85 degrees F for at least 7 days after placing.

B. Cold Weather Concrete Operations:
   1. Comply with the recommendations of ACI 306R.
   2. Recommended Protective Measures:
      a. Heating materials.
      b. Providing insulating blankets and windbreaks.
      c. Heated enclosures.
   3. Advise Engineer of planned protective measures.
   4. Straw or similar materials shall not be allowed.
   5. Do not use frozen materials or materials containing ice or snow.
   6. Do not place concrete on frozen subgrade.

C. Hot Weather Concrete Operations:
   1. Comply with the recommendations of ACI 305R.
   2. Recommended Protective Measures:
      a. Cooling materials.
      b. Concrete placement during cooler hours of the day.
      c. Providing shading and windbreaks.
   3. Advise Engineer of planned protective measures.

D. Preparation of Base:
   1. Excavate to the required depth and to a width that will permit forming.
   2. Remove unsuitable material below the required depth and replace with sound earth.
   3. Shape and compact the base to conform to the section indicated on the Drawings.

E. Forms:
   1. Use fixed forms.
   2. Apply form releasing agent to prevent concrete from bonding to forms.
   3. Provide straight, full depth forms free of warp and strong enough to resist springing during concrete placement.
   4. Firmly stake fixed forms to prohibit movement.

F. Reinforcing:
   1. Place reinforcement in accordance with CRSI placing reinforcement bars and Manual of Standard Practice.
   2. Tolerances indicated in ACI 117.
   3. 3-inch minimum cover.

G. Placing and Finishing Concrete:
   1. Place all concrete in accordance with ACI 304R and ACI 304.2R.
   2. Moisten base before placing concrete.
   3. Place concrete and consolidate, including along the faces of the forms, before finishing.

4. Place and finish in a continuous operation.
5. When replacing gutters along with concrete walk ramps, construct the gutter to the same dimensions and profile and use the same reinforcement pattern as the existing gutter.
6. Float the surface just enough to produce a smooth surface free from irregularities.
7. Round edges and joints with an approved finishing tool.

H. Joints:
1. General: Comply with ACI 318-6.3, 6.4, and ACI 301, Section 6. Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to the centerline, unless otherwise indicated on the Drawings.
2. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as indicated on the Drawings. Contraction joints for curbs shall be 1-1/2 inch deep provided at 10 foot intervals unless indicated otherwise on the Drawings.
3. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such placements terminate at expansion joints.
4. Install expansion joints at the spring point of curves of all radius curbs. For curbed islands install 2 expansion joints at opposite ends of island at spring points.
5. Install expansion joints 10 feet either side of catch basins, and every 300 feet longitudinally.

I. Backfilling:
1. After the concrete has gained sufficient strength, remove fixed forms and backfill with sound earth.
2. Compact and level the backfill 1-inch below the surface of the concrete.

3.3 CONCRETE FINISHING

A. After striking-off and consolidating concrete, smooth surface by screening and floating. Use hand method only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a 10 foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing to create a non-slip finish by scoring the surface with a fine-hair broom, perpendicular to the line of traffic. Repeat operation if required to provide a fine line texture acceptable to the Engineer. Finish edges with 1/2-inch radius.

D. Do not remove forms for 24-hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by the Engineer.

3.4 CURING

A. General: After texturing operations have been completed and after the free water has left the surface, coat the concrete with 1 coat of a uniform layer of membrane curing compound.

3.5 PROTECTION

A. Protect from damage until acceptance of the Work.

B. Protect the concrete from freezing until the concrete has attained a compressive strength of at least 1000 psi.

C. Maintain as clean as practical by removing surface stains and spillage of materials as they occur.

3.6 FIELD QUALITY CONTROL

A. The following list of deficiencies shall be considered defective work if found within 1 year of installation, and shall be replaced by the Contractor at no cost to the Owner:
   1. Gutters that pond more than 1/4-inch of water.
   2. Cracks of any length that are 1/8-inch wide or wider.
   3. A hole that is 1/2-inch or greater in depth and 2 inches or greater in diameter.
   4. Residual splatter that is 1/2-inch or higher than adjacent concrete.
   5. Elevation difference of 1/4-inch in 10 feet caused by settling or improper forming.
   6. Footprints, bike tire tracks, animal tracks, or the like, created while concrete was not cured.

3.7 CLEANING

A. Maintain work area free of waste, material and debris.

END OF SECTION 32 16 13

SECTION 32 17 23 – PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes parking lot and roadway striping consisting of providing and applying retroreflective permanent pavement markings in accordance with the Manual on Uniform Traffic Control Devices. Provide markings, shapes, spacing, and dimensions that conform to the State DOT Pavement Marking Standard Plans.

1.3 REFERENCES

A. Comply with standards in effect as of the date of the Contract Documents except for those having different revision dates as referenced in the codes or as indicated on the Drawings.

B. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. TT-P-1952D, Federal Specification: Paint, Traffic and Airfield Marking, Waterborne.
   2. United States Department of Transportation – Federal Highway Administration:
      a. Manual on Uniform Traffic Control Devices (MUTCD).
   3. State DOT Current Standards: Manual on Uniform Traffic Control Devices.

1.4 SUBMITTALS

A. Product Data:
   1. Provide a detailed schedule for construction.
   2. Provide manufacturer data sheet on each material to be used.

1.5 QUALITY ASSURANCE

A. Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation.

B. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKINGS

A. Marking paint shall meet Federal Specification GSA-FSSTT-P-115E Type 1.

B. Size and Color: 4-inch width, white, yellow, blue or other color depending on intended use.
   1. As indicated on the Drawings.
   2. In accordance with guidelines, State MUTCD and FHWA – MUTCD.

C. Materials to be Used:
   1. Parking Lot Parking Stalls: Waterborne.
   2. Parking Lot Lane Striping: Waterborne.
   3. Parking Lot Stop Bars: Waterborne.
   4. Road Striping: Waterborne.
   5. Road Stop Bars: Waterborne.

D. Traffic paint shall be spray or hot-applied type for stripe marking. Contractor may use one of the following, or equal:
   1. Repcolite:
      a. 47610 Traffic Marking Paint; White.
      b. 47660 Traffic Marking Paint; Yellow.
      c. 47630 Traffic Marking Paint (Barrier Free Blue).
   2. Sherwin Williams:
      a. Setfast Low VOC Acrylic Traffic Marking Paint; TM 5626 (White), TM 5627 (Yellow).
      b. Setfast Acrylic Waterborne Traffic Marking Paint; TM 226 (White), TM 227 (Yellow).
      c. Hotline Fast Dry Latex Waterborne Traffic Marking Paint; TM 2152 (White), TM 2153 (Yellow).
   3. Epoplex: LS90 Polyurea liquid pavement marking system.
   4. Swarco: Swarcotherm EWH 131 and EYH 132.
   5. Geveko Markings: Viatherm E413W.

E. Thickness (mil) For Single Application:
   1. Waterborne: 15 mil (110 sq. ft./gallon).
   2. Thermoplastic: 90 mil for surface applications, 125 mils for recessed applications
   3. Polyurea: 20 mil.

F. If the Contract requires a second application of permanent pavement markings, complete 2 applications regardless of initial pavement marking conditions. Complete the second application from 14 days to 60 days after initial application in the same calendar year.

G. Apply the second application before the required 14 days if previously approved by the Engineer.

Minimum Material Placement Temperature and Seasonal Restrictions

Material	Minimum Air Temperature (F) During Application	Minimum Dry Pavement Temperature (F)	Start Date	End Date
Waterborne	50	50	May 1	Oct. 15
Low Temperature Waterborne	35	35	Oct. 1	May 1
Regular Dry	25	25	Oct. 1	May 1
Cold Plastic Tape With Contact Cement	60	60	May 1	Oct. 15
Cold Plastic Tape Primerless – without Surface preparation Adhesive	60	60	Jun. 1	Sept. 1
Cold Plastic Tape Primerless – with Surface preparation Adhesive	40	40	Apr. 15	Nov. 15
Thermoplastic	50	50	May 1	Oct. 15
Sprayable Thermoplastic	50	50	Apr. 15	Nov. 15
Polyurea	40	10	Apr. 15	Nov. 15

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare as indicated on the Drawings for layout of pavement markings, symbols, and all associated dimensions, details and requirements.

B. Measure pavement and mark pavement marking locations with chalk lines on parking lots or grease pencil to be sure all dimensions comply with the Drawings.

C. Before applying pavement markings, ensure the pavement surface is clean, dry and in sound condition. Remove any dust, oil, grease, dirt, loose rust and other foreign material. Air blast to remove material that prevents pavement markings from adhering to the pavement surface.

D. Apply longitudinal lines with certified self-propelled pavement marking equipment. Contact the Engineer for approval of using other equipment for special markings or areas inaccessible to self-propelled pavement marking equipment.

E. Provide self-propelled equipment certified with the Equipment Certification Guidelines for Pavement Markings. Certification is effective for 2 years. Operate marking equipment at no greater than the certified speed.

F. Use equipment capable of uniformly applying material to the required length and width. Provide equipment for placing centerlines, capable of applying a minimum of three 4-inch lines on a two-lane road in one pass. If applying multiple centerlines, use 3 spray guns positioned 6 inches on center. For two lane freeways, apply the lane line from the left lane.

G. Use equipment for placing hot-applied thermoplastic and sprayable thermoplastic material that can maintain the temperature recommended by the material manufacturer.

H. Prepare new and existing hot mix asphalt (HMA) surfaces open to traffic for 10 days or less with no oil drips, residue, debris, or temporary or permanent markings, by cleaning the marking area with compressed air.

I. Prepare new and existing Portland Cement Concrete (PCC) surfaces free of oil drips, residue, and debris, temporary, or permanent markings, by removing the curing compound from the area required for pavement markings.

J. Prepare existing HMA or PCC surfaces that do not have existing markings, but may have oil drip areas, or both, by scarifying the marking area using non-milling grinding teeth or shot blasting. Use of water blasting to scarify the marking area on PCC surfaces is allowed.

3.2 PAVEMENT MARKING

A. Apply pavement marking in accordance with state DOT and FHWA requirements.

B. For solid lines, apply 4 inch and 6 inch lines, no greater than 1/4 inch wider than the required width. Apply solid lines with no gaps or spaces. Apply a double line as either 2 solid lines or 1 solid line and 1 broken line.

C. Mix liquid materials during application. Do not thin materials. Uniformly apply pavement marking material at the rates indicated by the manufacturer.

D. Operate striping equipment to prevent traffic from crossing the uncured markings. Prevent vehicles from being sprayed.

E. Apply sharp, well-defined markings, free of uneven edges, overspray, or other visible defects, as determined by the Engineer. Ensure pavement marking lines are straight, or of uniform curvature. Pavement markings are subject to inspection by the Engineer. Remove pavement markings outside the required tolerances and re apply in the correct locations. Also re apply unprotected pavement markings damaged by traffic and remove tracked lines at no additional cost to the Owner.

F. Ensure the material application rates, the temperature and seasonal application restrictions listed in the Table after Paragraph 2.1 G. Also ensure the additional requirements indicated in this Article for specific materials are met when applying any material, unless directed by the Engineer.

G. Protect pavement marking from traffic crossing over uncured paint.

H. Re apply lines washed away or otherwise damaged by rain at no additional cost to the Owner.

I. Regular Dry Paint: Wait at least 14 days after placing the pavement surface before applying regular dry pavement markings to new HMA wearing surface. The Engineer may consider waiving the 14 day waiting period if conditions dictate.

J. Cold Plastic:
   1. Prepare the pavement surface and apply the cold plastic tape in accordance with the manufacturer's specifications.
   2. Remove curing compound from new concrete surfaces before applying cold plastic tape.
   3. Install cold plastic tape legends, crosswalks, and stop bars, as shown on the standard plan requirements, unless otherwise required in the Drawings.

K. Primerless – Without Surface Preparation Adhesive:
   1. Ensure dry weather for at least 24 hours, and dry pavement surface before applying the primerless cold plastic tape marking. Clean the pavement surface using an air compressor with at least 185 cfm air flow and 120 psi.
   2. Immediately after placement, roll transverse and special markings at least 6 times with a roller weighing at least 200 pounds.

L. Thermoplastic:
   1. It is the Contractor's responsibility to ensure the pavement is free of excess surface and subsurface moisture that may affect bonding.
   2. Heat and apply the thermoplastic material within the temperature range recommended by the manufacturer.
   3. Heat and apply the sprayable thermoplastic material within the temperature range recommended by the manufacturer.

M. Polyurea:
   1. Ensure the pavement is free of excess surface and subsurface moisture that may affect bonding.
   2. Surface preparation requirements for special, and longitudinal polyuria pavement markings depend on surface conditions.

3.3 CLEANING

A. Prior to acceptance of the work, clean the pavement and related areas to remove dirt and stones.

END OF SECTION 32 17 23

SECTION 321823.29 - SYNTHETIC TURF (NON-ATHLETIC)

PART 1 - GENERAL

1.1 SUMMARY:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. The work under this section shall consist of furnishing all labor, materials and equipment, necessary to install, in place, all synthetic turf and associated materials as indicated on the plans and as specified herein. The installation of all new materials shall be performed in strict accordance with these specifications, the manufacturer's instructions and in accordance with all details and shop drawings. The scope of work shall include the following:

1. Artificial Turf System by Forever Lawn
   a. Model: Playground Grass Ultra
2. Submit warranty information and samples of products specified
3. Warranty – per manufacturer
4. Review and certification of previous work performed by other Subcontractors, relating to the work of this section.

1.3 QUALITY ASSURANCE:

A. Installer: Installation team shall be established and experienced with synthetic turf installation with a minimum of 5 years experience.

B. Resumes: Bidder shall submit, with the Bid Proposal, resumes detailing level of experience of each installation foreman or supervisor.

C. Manufacturer's Instructions: Comply with the manufacturer's applicable instructions and recommendations for installation to whatever extent these are more stringent or explicit than indicated in the contract documents.

D. Materials: All supplied and installed materials and products will meet or exceed the minimum specifications designated in this section.

E. References: The Manufacturer/Installer team shall provide information to demonstrate a minimum of 5 years of successful experience in the installation of systems similar to that covered by this specification.

F. Samples: The Manufacturer/Installer shall provide the following samples of the artificial turf selected for this project within 14 calendar days after the Notice to Proceed.

1. (4) 1'x1' samples of turf specified.

G. Maintenance and Operational Data: At the completion of the project, submit 5 complete sets, in manual form, of all the manufacturer's recommended procedures and materials for, but not limited to:

1. General Maintenance
2. Small Repair Procedures
3. Cleaning
4. A list of all procedures required to maintain the surface condition and activities and/or procedures to be avoided in order to prolong the life and maintain the warranty-including static and dynamic load limits, snow clearing, etc.

H. Warranty Samples: Submit 3 “sample copies” of the PROPOSED WARRANTY” to be provided at the completion of the Contract. Warranty period shall be not less than eight (8) years after final acceptance.

PART 2 - PRODUCTS

2.1 PRODUCTS:

A. The turf system shall consist of an artificial grass-like surface pile, which shall be tufted into an artificial backing and installed on stone base or concrete pavement (See Plan).

B. The entire system shall be resistant to weather, insects, rot, mildew, and fungus growth, and will be non-allergic and non-toxic.

C. The entire system shall be constructed for porous standards as specified.

D. The fabric surface will be installed in 15-foot width (minimum).

E. All synthetic turf seams shall be sewn with a double-lock stitch, or glued.

F. The dynamic cushioning of combined turf and pad system supplied shall not exceed an average minimum value of 200 G’s, or less, at 70° F upon installation, utilizing ASTM Test F- 355-95, not to exceed 200 G’s over warranty period.

G. The entire system will be constructed to maximize dimensional stability, to resist damage, resistant to ultraviolet radiation, and sustain normal wear and tear for its designated uses.

H. All adhesives used in bonding the inlaid markings to be substrate shall be resistant to moisture, bacteria and fungus attacks, and resistant to ultraviolet radiation. The adhesive shall be made especially for the adhesion of synthetic turf to elastic-layer and/or seaming tape.

2.2 FABRIC SURFACE:

A. The fabric surface shall consist of tufted silt film or monofilament polyethylene or polypropylene fiber tufted to at least two (2) polypropylene backings, and coated with a secondary backing of totally inert synthetic material with a minimum weight of 25 oz. /per sq. yd.

B. The pile surface will resemble freshly mown natural grass in appearance, texture, and color.

C. The pile surface will be a nominally uniform in length.

D. The pile fiber angle will be 90 degrees ± 15 degrees, measured from the horizontal after installation of the infill material.

E. The fabric backing is to be bonded with a shock absorbing pad using a moisture cure urethane adhesive (100% MDI) applied mechanically to guarantee bond uniformity.

F. The turf system shall have a nominal fiber length of 2.2” - 2.4”.

G. Each roll shall be 15’ wide and cross-laid from opposite ends each width.

2.3 INFILL MATERIAL:

A. Rubber infill particles shall be recycled granulated SBR rubber free of belting fabric and/or wire, with a minimum fill height of 1”.

2.4 BASE MATERIAL:

A. Base material to be ¾” clear natural aggregate, depth as indicated on plans.

PART 3 - EXECUTION

3.1 CERTIFICATION OF BASE CONSTRUCTION:

A. General: A written “Certification of Acceptance of the Base Construction” is required from the artificial turf/surfacing system prior to proceeding with any installation work under this contract.

B. Scope: This certification shall include but not be limited to the acceptance of:

1. The base construction finish surfaces are completely acceptable for the application of work specified under this section.
2. The materials and method of installation for the aggregate stone base construction is in conformance with the manufacturer’s current recommendations for the application of the elastic-layer and turf to be installed under this section.
3. The aggregate stone base construction is totally suitable for work to proceed with the assurance that the final installation of the work under this section will result in a high quality athletic surface fully warranted for the period and conditions specified therein. In order to provide these assurances and the certificate of acceptance, the turf system Installer shall cooperate and communicate fully, at all times, with the Owner’s Representative and Landscape Architect. This Subcontractor shall be responsible for reviewing all related work, materials and procedures herein. He shall inspect each process of the asphalt base construction work and certify that conditions and tolerances required for application of the artificial turf system are being met.
4. All discrepancies between the required materials, application and tolerance requirements noted by the Installer shall be brought immediately to the attention of the Owner’s Representative, Landscape Architect, and Contractor. Failure to immediately inform the Owner’s Representative, Landscape Architect, and Contractor of any prior work which does not meet the required specifications for installation of the artificial turf surfacing system shall be considered an acceptance by the installer of the non-conforming work. Any additional work later required to bring the base to acceptable conditions shall be preformed by this Installer at no additional cost to the Owner. Any discrepancies in the prior work which does not meet the specifications and noted in writing to the Owner’s Representative and Landscape Architect shall be preformed immediately at no additional cost to the Owner.

3.2 INSTALLATION OF THE TURF:

A. General: All installation shall be done in strict accordance with the manufacturer's current printed installation instructions approved by the Owner's Representative and Landscape Architect.

B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative and Landscape Architect at no additional cost to the Owner.

C. Environmental Conditions: Weather conditions are important for the successful installation of the systems. No work under this section will proceed when:

1. Ambient air temperatures are below 50 degrees F.
2. Material temperatures are below 50 degrees F.
3. Surfaces are wet or damp.
4. Rain is imminent or falling.
5. Conditions exist or are imminent, which will be unsuitable to installation requirements of the systems specified herein. Humidity levels will be inside the limits recommended by the adhesive manufacturer to obtain optimum bonding characteristics of the surfaces.

D. Work Quality: The bonding design and work shall be such that all surface joint and seams shall remain as required above throughout the duration of the warranty period at a minimum.

E. Seam Spacing:

1. All seams widths are to be held to the absolute minimum and as approved.
2. All lateral seams are to be glued.

F. Edges: Turf edges will be shown on details and specified herein.

1. Turf shall be attached to 2 x 4 nailer board with stainless steel fender washers and screws spaced per manufacturer recommendations so as to prohibit carpet lift.

END OF SECTION 321823.29

SECTION 323216 – PRECAST CONCRETE RETAINING WALL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of retaining walls is shown on drawings.

B. Type of Retaining Walls Required Include the Following:

1. Segmental concrete masonry retaining walls with soil reinforcement as indicated on drawings.

C. Related Work Specified Elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 SYSTEM PERFORMANCE REQUIREMENTS:

A. Engineering Responsibility: Engage a manufacturer who assumes undivided responsibility for engineering segmental concrete retaining walls by employing a Registered Professional Engineer specializing in structures in the State of Michigan.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical data and other information for each retaining wall material or product required, including but not limited to soil reinforcement if required by engineer, and filter fabric.

B. Shop Drawings: Submit shop drawings for approval indicating layout and construction of proposed retaining wall. Design drawings shall be prepared by manufacturer for segmental concrete retaining walls. Show height, length, profile, soil reinforcement, base and drainage fill.

1. Include structural analysis data signed and sealed by a qualified professional engineer responsible for their preparation, registered in the State of Michigan.

C. Samples for Verification Purposes: Sets for each color, finish and pattern of concrete unit required. Include sample of concrete wall units showing the full range of variations expected for approval prior to ordering of concrete wall units.

1.5 QUALITY ASSURANCE:

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Industry Standards: Comply with recommendations of National Concrete Masonry Association (NCMA) and the Interlocking Concrete Pavement Institute (ICPI) as applicable.

C. Installer Qualifications: Engage an experienced installer with a minimum of (5) years experience who has completed segmental retaining walls similar in material, design and extent to that indicated for Project that has resulted in construction with a record of successful in-service performance.

1.6 PROJECT CONDITIONS:

A. Test borings and other exploratory operations may be performed by Retaining Wall Contractor, at the Retaining Wall Contractor's option; however, no change in the contract sum will be authorized for such additional exploration.

B. Protection: Protect existing structures, utilities, sidewalks, pavements and other facilities in areas of work. Barricade open excavations and provide warning lights. Comply with regulations and requirements of authorities having jurisdiction.

1.7 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to project site in an undamaged condition.

B. Store and handle retaining wall units and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping or other causes.

C. Store accessories to prevent corrosion and accumulation of dirt or oil

D. Store and handle geotextiles according to ASTM D-4873.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Base: Gravel or crushed stone, MDOT 21AA

B. Drainage Fill: 6A crushed washed limestone, 1" x 3/8" clean drainage fill.

C. Soil Reinforcement: Biaxial Geogrid specifically manufactured for use as soil reinforcement and with necessary properties to comply with performance requirements.

D. Filtration/Separation Fabric: Manufacturer's non-woven geotextile fabric of polypropylene or polyester fibers, or a combination thereof.

1. US Fabrics US 160NW
2. Mirafi 160 N

E. Construction adhesive: Adhere concurrent wall courses and caps with an approved construction adhesive. Construction adhesives shall be one of the following or approved equal:

1. Pave Chem, Type 1-Flexible Adhesive or Type 3 – superwet adhesive. Manufactured by Pave Tech, NC. Ph: (800) 728-3832.
2. SRW Retaining Wall and Paver Adhesive Manufactured by SRW Products (800) 752-9326, www.srwproducts.com.
3. Apply adhesives per manufactures guidelines.

2.2 SEGMENTAL CONCRETE MASONRY MATERIALS:

A. Segmental Concrete Masonry Units: Provide manufacturer's standard high-strength, regular-weight concrete units, designed for use in segmental retaining walls, complying with ASTM C-90, except with net area compressive strength of 3000 psi for average of 3 units and 2500 psi for individual unit, maximum water absorption of 8 percent, and variation in height limited to 1/16 inch.

1. Provide units with lugs, projections, or holes and pins that locate successive courses in relation to the course below and maintain that alignment as backfill is placed, and that interlock with units above and below unless specified elsewhere in the contract documents.
2. Shapes: Provide units of basic shapes and dimensions unless specific shapes are indicated.
3. Exposed Faces: Manufacturer's standard face condition for specified product unless noted otherwise.
4. Special Units: Provide special corner, end and cap units, and other special shapes as necessary matching exposed faces of segmental concrete masonry units.
5. Precast concrete segmental masonry units shall be manufactured by Techo-Bloc; techo-bloc.com.

a. Product: Raffinato Wall
b. Finish: Smooth
c. Color: T.B.D.
d. Size: 90 mm series
e. Cap: 60 mm series

B. Connecting Pins: Manufacturer's standard non-corrosive nylon fiberglass reinforced units.

C. Concrete Adhesive: Manufacturer's standard formulated to adhere cap units to segmental concrete masonry wall construction.

PART 3 - EXECUTION

3.1 EXCAVATION:

A. Excavate to required depth and configuration as specified on the drawings.

B. Compact top 12 inches below subgrade to not less than 95 percent maximum density in accordance with ASTM D-1557.

C. Construct leveling pad on compacted subgrade for precast concrete retaining walls not less than 6 inches thick extending not less than 6 inches from front and back of initial course. Use specified granular fill material, and compact to not less than 95 percent maximum density in accordance with ASTM D-1557.

3.2 SEGMENTAL CONCRETE RETAINING WALLS:

A. General: Place units according to manufacturer's written instructions and in accordance with Design Drawings. Lay units in running bond, overlapping half units of course below.

1. Form corners and ends by using manufactured special units.

B. First Course: Place first course of retaining wall units on leveling base/course for full length of wall. Place units in firm contact with each other, properly aligned and level.

1. Tamp units into leveling base as necessary to bring tops of units into a level plane.
2. Place and compact drainage fill as indicated to top of first course. Place fill on both sides of wall at same time without disturbing alignment of units. Fill voids between and within units with drainage fill.

C. Subsequent Courses: Sweep excess fill from tops of course below. Place units in firm contact, properly aligned, and directly on course below:

1. Carefully align holes in units above with holes below and insert pins according to manufacturer's written instructions.
2. Place and compact fill as each course is laid. Place fills on both sides of wall at same time, where both sides are indicated to be filled.
3. Fill voids between and within units with drainage fill.
4. Verify subsequent courses are level.

D. Cap Units: Place cap units and secure with cap adhesive according to manufacturer's written instructions.

3.3 BACKFILL:

A. Backfill retaining walls promptly as work progresses.

B. Prepare ground surface to receive fill by removing vegetation, debris, unsatisfactory soil materials and obstructions. Scarify as required so that fill material will bond with existing surface.

C. Place specified and referenced soil material in layers to required subgrade elevations.

D. Place backfill soil materials in layers not more than 8 inches in loose depth, compacting each layer to specified density. Do not place fill or backfill materials on surfaces that are muddy, frozen or contain ice or frost.

E. Place, spread and compact fill in uniform lifts for full width and length of embankment as wall is laid. Begin at back of wall and place and spread fill toward embankment.

1. Use only hand-operated compaction equipment within 36 inches of wall.
2. Compact drainage fill to not less than 95 percent maximum dry density according to ASTM D-1557.
3. Compact reinforced soil fill to not less than 95 percent maximum dry density according to ASTM D-1557.

F. Place soil reinforcement in horizontal joints of retaining wall according to soil reinforcement manufacturer's written instructions. Embed reinforcement a minimum of 8 inches into retaining wall and stretch tight over compacted backfill. Anchor soil reinforcement before placing fill on it.

1. Use additional soil reinforcement at corners and curved walls to provide continuous reinforcement and to comply with manufacturer's written instructions.
2. Before compacting, place sufficient depth of fill over reinforcement to produce compacted depth of 4 inches for wheeled vehicles or 6 inches for tracked vehicles.
3. Do not turn vehicles on fill until first layer of fill is compacted and second layer is placed over each soil-reinforcement layer.

G. Coordinate backfill placement with installation of Underdrainage System Specification Section 334600.

H. Rough grade to allow for placement of topsoil, Specification Section 329119 – Topsoil.

3.4 MAINTENANCE:

A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and re-establish grades in settled, eroded and rutted or otherwise damaged areas. In damaged compacted areas, scarify surface, reshape and compact to required density prior to further construction.

3.5 DISPOSAL OF EXCESS AND WASTE MATERIALS:

A. Remove trash, debris excess soil materials and waste materials and legally dispose of off Owner's property.

END OF SECTION 323216

SECTION 328400 – IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements and General and Supplemental Requirements, which are hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of irrigation system work is shown on drawings and by provisions of this Section.

B. The sprinkler system shall be constructed using sprinklers, valves, piping, fittings, controllers, wiring, etc., of size and types as indicated in these specifications. The system shall be constructed to grades and conform to areas and locations as shown on the drawings.

C. Sprinkler lines shown on the drawings are essentially diagrammatic. Spacing of the sprinkler heads or quick coupling valves is shown on the drawings and shall be exceeded only with the permission of the Owner's Representative and Landscape Architect.

D. Unless otherwise specified or indicated on the drawings, the construction of the sprinkler system shall include the furnishing, installing and testing of all mains, laterals, risers and fittings, sprinkler heads, drip tubing, quick coupling valves, automatic control valves, manual valves, control timers, weather sensors, flow meters, controller remotes, and other necessary specialties and the removal and/or restoration of existing improvements, excavating and backfill, and all other work in accordance with plans and specifications as required for a complete system.

E. The entire system shall conform to local standards and requirements for landscape irrigation systems.

F. The design shall incorporate proven water saving technology.

1.3 SUBMITTALS:

A. Submit specific product information including make and model number to the Owner's Representative and Landscape Architect on backflow devices, valves, valve boxes, two-wire cable (as applicable), two-wire decoders (as applicable), sprinklers, nozzles, drip tubing, drip valve kits, controller, weather sensors, flow meters, wire connectors and wire, all pipe and fittings, clamps, pumps (if required), enclosures, to be used on the project prior to purchasing materials. Submittals are subject to the irrigation consultant's approval.

B. Upon irrigation system acceptance, submit written operating and maintenance instructions. Provide format and contents as directed by the Owner's Representative and Landscape Architect. Include instruction sheets and parts lists for all operating equipment.

C. Provide a reproducible irrigation system record drawing including an electronic copy on a cd showing sprinkler heads, valves, field splices, drains and pipelines including quick coupler and automatic valves. Drawing is to be given to the Owner's Representative and Landscape Architect at the final irrigation system walkthrough. Also include zone chart in each control timer along with colored drawing indicating extent of zones.

1. Legibly mark drawings to record actual construction.
2. Indicate horizontal locations, with a minimum of two dimensions to permanent surface improvements.

3. Identify field changes of dimension and detail and changes made by Change Order.

1.4 QUALITY ASSURANCE:

A. The Contractor shall maintain continuously a competent superintendent, satisfactory to the Owner's Representative and Landscape Architect, with authority to act for him in all matters pertaining to the work.

B. Superintendent shall hold certification as a Certified Irrigation Contractor with the Irrigation Association. Owner's Representative reserves the right to waive this certification requirement.

C. The Contractor shall hold valid licensing in states where Irrigation Contractors must be licensed to install commercial irrigation systems.

D. The Contractor shall coordinate his work with the other trades.

E. The Contractor shall confine his operations to the area to be improved and to the areas allotted him by the Owner's Representative for material and equipment storage.

F. The Contractor shall have a minimum of 5 years experience installing irrigation systems of comparable size and complexity.

G. It shall be the Contractor's responsibility to ensure and guarantee satisfactory operation of the entire system and the workmanship and restoration of the area. The entire system shall be guaranteed to be complete and perfect in every detail for a period of one year from the date of its acceptance and he hereby agrees to repair or replace any such defects occurring within that year, free of expense to the Owner. The Contractor shall winterize the system the first year. Minor maintenance and adjustment shall be by the Owner.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver irrigation system components in manufacturer's original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, both threaded or plain.

C. Store and handle materials to prevent damage and deterioration.

D. Provide secure, locked storage for valves, sprinkler heads and similar components that cannot be immediately replaced, to prevent installation delays.

1.6 PROJECT CONDITIONS:

A. The bidder acknowledges that he has examined the site, plans and specifications, and the submission of a proposal shall be considered evidence that examination has been made.

B. It shall be the contracting installer's responsibility to report to the Owner's Representative and Landscape Architect any deviations between drawings, specifications and the site. Failure to do so prior to the installing of equipment and resulting in replacing and/or relocation equipment shall be done at the Contractor's expense.

C. The exact location of all existing utilities and structures and underground utilities are not indicated on the drawings; their locations shall be determined by the Contractor, and he shall conduct his

work so as to prevent interruption of service or damage to them. The Contractor shall protect existing structures and utility services and be responsible for their replacement if damaged.

D. Minor adjustments in system layout will be permitted to clear existing fixed obstructions. Final system layout shall be acceptable to the Owner's Representative and Landscape Architect.

1.7 CODES AND STANDARDS:

A. The entire installation shall fully comply with all local and state laws and ordinances and with all established codes applicable thereto.

B. Any permits for the installation of construction of the work included under this contract which are required by any of the legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examinations required by these authorities.

C. In all cases where inspection of the sprinkler system work is required and/or where portions of the work are specified to be performed under the direction and/or inspection of the Owner's Representative and Landscape Architect, the Contractor shall notify the Owner's Representative and Landscape Architect at least 24 hours in advance of the time and such inspection and/or direction is required.

D. Any necessary re-excavation or alterations to the system needed because of failure of the Contractor to have the required inspections shall be performed at the Contractor's own expense.

1.8 SERVICE AND MAINTENANCE:

A. The Contractor shall service the system at the request during the guarantee period and shall be paid for work performed which is not covered by the guarantee. The Contractor shall winterize the system the first year as part of this contract, and will provide written instructions to the Owner for future service and maintenance.

B. Return to the site during the subsequent spring season and demonstrate to the Owner the proper procedures for the system start-up, operation and maintenance.

C. After completion, testing and acceptance of the system, the Contractor will instruct the Owner in the operation and maintenance of the system.

1.9 OWNER'S ACCEPTANCE:

A. The completion of the contract will be accepted and Notice of Completion recorded only when the entire contract is completed to the satisfaction of the Owner's Representative and Landscape Architect.

B. Within ten (10) days of the Contractor's notification that the installation is complete, the Owner's Representative and Landscape Architect will inspect the installation and if a final acceptance is not given, will prepare a "Punch List" which, upon completion by the Contractor, will signify acceptance by the Owner's Representative and Landscape Architect.

C. Final payment will not be made without the receipt of an accurate as-built drawing by the Landscape Architect.

1.10 WARRANTY:

A. It shall be the Contractor's responsibility to ensure and guarantee satisfactory operation of the entire system and the workmanship and restoration of the area. The entire system shall be guaranteed to be complete and perfect in every detail for a period of one year from the date of its acceptance and he hereby agrees to repair or replace any such defects occurring within that year, free of expense to the Owner. Minor maintenance and adjustment shall be by the Owner.

B. Contractor to guarantee that all trenches and other disturbed areas to be free from heaving or settling more than one-quarter (1/4"). Should it become necessary to adjust the grade, re-grade the trench and re-sod. This no-settlement clause shall extend over the entire period of guarantee of the job.

C. One month prior to the conclusion of the warranty period, the Owner’s Representative, Landscape Architect, and Contractor shall meet at the site and adjust the zone watering times on the controller to reflect run times for established plant material.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. General:

1. All materials to be incorporated in this system shall be new and without flaws or defect and quality and performance as specified. All material overages at the completion of the installation are the property of the Contractor and are to be removed from the site.
2. The Contractor shall use materials as specified. Material other than specified will be permitted only after written application by the Contractor and written approval by the Owner’s Representative and Landscape Architect. Substitutions will only be allowed when in the best interest of the Owner.

B. Pipe and Fittings:

1. Pipe sizes shall conform to those shown on the drawings. No substitutions of smaller pipe sizes will be permitted, but substitutions of larger size may be approved. All pipe damaged or rejected because of defects shall be removed from the site at the time of said rejection.
2. Provide pipe continuously and permanently marked with manufacturer's name or trademark, size schedule and type of pipe working pressure at 73 degrees F. and National Sanitation Foundation (NSF) approval.
3. All mainline piping and underground piping under continuous pressure plus all pipe 2-1/2” or larger whether a lateral or mainline, shall be rigid, un-plasticized polyvinyl chloride pipe extruded from virgin parent material, ASTM D-2241. Provide pipe homogeneous throughout and free from visible cracks, holes, foreign materials, blisters wrinkles and dents.
4. PVC Pipe and sleeving shall be SDR 21, Class 200 unless stated otherwise on the drawing.
5. PVC Pipe 3” and smaller and all sleeving shall be solvent weld type.
6. PVC pipe fittings for sizes 3" and smaller and all sleeving shall be ASTM D-2466 schedule 40 PVC molded fittings suitable for solvent weld.
7. All fittings for PVC pipe 4” and larger shall be ductile iron as manufactured by Harco.
8. All threaded PVC pipe-fittings shall be ASTM D-2467, Schedule 80 PVC.
9. Saddle and cross fittings are not permitted. Use male adapters for plastic to metal connections. Hand-tighten male adapters plus one turn with a strap wrench.
10. Areas using polyethylene lateral pipe: All pipe downstream from zone valves sized 2” and smaller, shall be flexible non-toxic polyethylene pipe. Polyethylene pipe shall be PE 3408, ASTM rated at 100 PSI minimum working pressure, and in conformance with ASTM D-

2239, NSF approved or as noted on the drawing. Pipe larger than 2" size shall be PSI as specified for mainlines. PE 2306 fittings for polyethylene pipe shall be ASTM D-2609 insert type fittings. Saddle and cross fittings not permitted. All joints shall be secured with stainless steel band and screw clamps.

11. Areas using PVC lateral pipe: All pipe downstream from zone valves sized 2" and smaller, shall be schedule 40 PVC pipe.
12. Primer and solvent for use with PVC pipe to conform to ASTM D-2564. Primer to be purple in color. Solvent to be appropriate for pipe and fitting type and weather conditions.
13. All above grade pipe shall be type 'L' copper. Fittings shall be cast brass or wrought copper.
14. Systems using reclaimed water as the irrigation system watersource shall use pipe that is lavender in color or of a specific color as deemed acceptable by the local water purveyor for reclaimed water.

C. Control System:

1. The automatic controllers and valves shall be as of the same manufacturer.
2. All controllers shall be locally available and be have local trouble shooting representatives.
3. All controllers shall have a proven record of successful performance in the project area. No controller will be approved for use that has not been available in the project area for less than one year from the final approval date on the irrigation design drawings.
4. All controllers shall be accompanied by a weather or soil moisture sensor manufactured by the controller manufacturer.
5. Controllers shall be grounded per manufacturer's recommendations.
6. All controllers and sensors shall be acceptable to the local water purveyor for landscape irrigation systems.
7. Include, as applicable, phone, Ethernet, radio, or cellular card depending on potential controller/off-site monitoring communication desired.
8. Include hand-held remote, model as recommended by controller manufacturer, to allow maintenance persons to operate individual zones without direct access to the controller.

D. Control Wire, Decoders, Flow Meters, and Connections:

1. Control wire and two-wire cable shall be Type UL approved, for direct burial and shall be Size 14 or larger, as recommended by the manufacturer for the conditions of the project. Conductor to be single strand soft annealed copper.
2. 24 volt control wires to be red in color. Common wire to be white in color.
3. Two-wire cable shall be manufactured by the controller manufacturer for specific use by that controller.
4. Two-wire decoders shall be manufactured by the controller manufacturer for specific use by that controller.
5. Two-wire cable and decoders shall be grounded per manufacturer's recommendations.
6. Flow meters shall be installed at all water sources. Flow meters shall be manufactured by the controller manufacturer.
7. Low voltage wire connectors to be made using 3M DBY connectors.
8. 120 volt or heavier splices made underground to be made using 3M DBY connectors.

E. Sprinkler Heads:

1. Sprinkler equipment shall be manufactured by Hunter (Pro-S), Rainbird (1800), or Toro (570Z) and include check valve and pressure regulating feature.
2. Sprinkler nozzles shall be matched precipitation variety as manufactured by the sprinkler body manufacturer or Toro Precision Nozzles with threads to match the sprinkler body
3. Stream rotary nozzles for spray sprinklers shall be as manufactured by the sprinkler body manufacturer.

4. Rotary sprinklers, ¾" shall be manufactured by Hunter (I-20), Rainbird (5000 series) or Toro (T5) and are to include check valve.
5. Rotary sprinkler nozzles shall be as manufactured for the sprinkler by the sprinkler body manufacturer. Minimum GPM output to be 2.0 GPM, maximum GPM output 6.0 GPM. Suggested nozzling shall be: 2.0 GPM, 90 degrees, 3.0 GPM, 180 degrees, 6.0 GPM 360 degrees.
6. Sprinklers fed from a reclaimed watersource shall have lavender caps.

F. Clamps (polyethylene lateral pipe):

1. Clamps to be stainless steel, worm gear hose clamps with stainless steel screw.

G. Automatic Valves and Quick Coupling Valves:

1. Valves shall be manufactured by Hunter, Rainbird, or Toro.
2. Models shall be Hunter ICV, Rainbird PEB, and Toro P-220. Size per manufacturer's recommendation for specific zone flow.
3. Valves shall have zone identification tag attached to the valve stem.
4. Valves installed on systems fed from a reclaimed watersource shall have lavender handles.
5. Install brass ball valve upstream of all automatic valves.
6. Quick coupler valves shall be manufactured by Hunter, Rainbird, or Toro and be 1" size.
7. Quick couplers shall have one piece body with locking lid and stabilized.
8. Quick couplers installed on systems fed from reclaimed water shall have lavender lids.

H. Manual Valves

1. Manual valves shall be manufactured by Nibco, Matco-Norca, or Red white.
2. Valves 3" and larger shall be gate valves, 200 #WOG, with solid wedge disc, conforming to federal specifications for its class.
3. Valves three inches (3") and larger shall be iron body bronze mounted, non-rising stem, with end connections for PVC pipe and have a two inch (2") square operating nut which turns to the left to open. Provide thrust block support.
4. Valves 2-1/2" and smaller shall be brass body ball valves, butterfly handle, with threaded connection.

I. Valve Boxes:

1. Valve access boxes shall be manufactured by Carson, Pentek, NDS, or Rainbird.
2. Valve Access Boxes to be tapered enclosure of rigid plastic material comprised of fibrous components chemically inert and unaffected by moisture corrosion and temperature changes. Provide lid of same material black in color.
3. Provide lavender lid for systems fed from reclaimed water.
4. Boxes to be 11" x 14" and of minimum size required to permit access to the valve. Side walls to extend at least 2" below the bottom of valve body; use extension as necessary.
5. Valve access boxes shall have filter fabric liner and gravel or pea stone sump.

J. Backflow Preventer:

1. Backflow preventers shall be reduced pressure zone type as manufactured by Watts, Febco, or Wilkins-Zurn.
2. Backflow preventers shall have air-gap discharge to floor drain.

K. Booster Pump (if required):

1. Booster pump shall be manufactured by Berkeley, Myers, or Flint and Walling.

2. Installation shall conform to all applicable electrical codes.
3. Pump is to start/stop from control timer of from pressure switch.
4. Booster pump shall include mercoid switch to suspend pumping operations if upstream pressure drops to 20 PSI

L. Subsurface Dripperline:

1. Dripperline to be manufactured by Hunter PLD-06-12, Netafim Techline CV, Rainbird XSF Dripline XSF-06-12, or Toro DL2000, RGP-2-12.
2. Subsurface irrigation tubing shall be self-flushing, pressure compensating dripperline with internal check valve at each emitter. Dripperline shall consist of nominal sized one-half inch low density, linear polyethylene tubing with internal pressure compensating, continuously self-flushing, integral drip emitters. The emitters shall have the ability to independently regulate discharge rates, with an output pressure of 7 to 70 PSI and shall continuously clean themselves while in operation.
3. Dripperline fed from a reclaimed watersource shall be lavender in color.
4. Dripperline shall have emitters spaced 12” o.c. and each emitter shall have .5 - .6 GPH emitter output.
5. Header pipe for all dripperline shall be schedule 40 PVC, 1” size.
6. All fittings shall be manufactured for use with the subsurface irrigation tubing by the subsurface dripperline manufacturer.
7. All associated system equipment including air relief valves, flush valves, pressure regulating valves and filters shall be manufactured for use with the subsurface irrigation tubing by the subsurface dripperline manufacturer.

M. Accessories:

1. Drainage fill: 1/2" x 3/4" washed pea gravel.
2. Fill shall be clean soil free of stones larger than 2" diameter, foreign matter, organic material and debris.
3. Provide imported fill material as required to complete the work. Obtain rights and pay all costs for imported materials.
4. Suitable excavated materials removed to accommodate the irrigation system work may be used as fill material subject to the Landscape Architect's review and acceptance.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine final grades and installation conditions. Do not start irrigation system work until unsatisfactory conditions are corrected.

3.2 PREPARATION:

A. Layout and stake the location of each pipe run and all sprinkler heads and sprinkler valves for coordination with Landscape Contractor. Obtain Landscape Architect's acceptance of main line layout prior to excavating, unless specifically waived by the Architect.

3.3 EXCAVATING AND BACKFILLING:

A. Excavating shall be considered unclassified and shall include all materials encountered, except materials that cannot be excavated by normal mechanical means. Excavate trenches of sufficient depth and width to permit proper handling and installation of pipe and fittings. Excavate to depths required to provide 2" depth of earth fill or sand bedding for piping when rock or other unsuitable bearing material is encountered.

B. Install sleeves for irrigation piping prior to paving. Minimum depth of bury for sleeves beneath roadways and drives, 36” and 18” beneath walks.

C. Sleeves needing to be installed beneath existing paving shall be installed by directional bore method. Minimum depth of bury for sleeves beneath roadways and drives, 36” and 18” beneath walks.

D. Pipe pulling will be allowed for lateral pipe only, provided soil moisture content and other conditions are suitable to allow for full depth of bury with a minimum of stretching and scraping of the pipe. Landscape Architect reserves the right to determine suitability or conditions. If the pulling method is used, the pipe "plow" shall be a vibratory type.

E. Fill to match adjacent grade elevation with approved earth fill material. Place and compact fill in layers not greater than 8" depth.

F. Provide approved fine-grained earth fill or sand to point 4" above the top of pipe, where soil conditions are rocky or otherwise objectionable.

G. Fill to within 6” of final grade with approved excavated or borrow fill materials free of lumps or rocks larger than 2” in any dimension.

H. The top 6” of backfill shall be topsoil, free of rocks, subsoil or trash. Any special soil mixture shall be replaced to the original condition it was prior to irrigation installation.

I. Except as indicated, install irrigation mains with a minimum cover of 24" based on finished grades. Install irrigation laterals with a minimum cover of 14" based on finished grades.

J. Excavate trenches and install piping and backfill during the same working day. Do not leave open trenches or partially filled trenches open overnight.

3.4 UNDERGROUND PIPE:

A. Install plastic pipe in accordance with manufacturer's installation instructions as ASTM D- 2274. Provide for thermal expansion and contraction.

B. Saw cut plastic pipe. Use a square-in-sawing vice, to ensure a square cut. Remove burrs and shavings at cut ends prior to installation.

C. Make PVC plastic-to-plastic joints with solvent weld joints. Use only primer and solvent recommended by the pipe manufacturer. Install plastic fittings in accordance with pipe manufacturer's instructions and ASTM D-2855. The Contractor shall make arrangements with pipe manufacturer for all necessary field assistance.

D. Allow joints to set at least 24 hours before pressure is applied to the system.

E. Uncoil poly-pipe and insert fitting full depth. Secure poly-pipe to insert fittings with stainless steel clamps. Double clamp pipe 1-1/2” diameter and larger.

F. Maintain pipe interiors free of dirt and debris. Close open ends of pipe by capping, taping or other acceptable method when pipe installation is not in progress.

G. All mainline and continuously pressurized pipe is to be installed using open trenches. Lateral pipe may be installed by "Plowing" if soil conditions permit, and soils do not contain gravel, rock, construction debris or other potential damaging material.

H. Install thrust blocks on the mainline pipe work in accordance with pipe manufacturer's written instructions.

3.5 SPRINKLER INSTALLATION:

A. Install fittings and sprinkler heads in accordance with manufacturer's instructions, except as otherwise indicated.

B. Set sprinkler heads perpendicular to finished grades, except as otherwise indicated, and position to prevent contact with grounds maintenance equipment. Install sprinklers 6" off walks and curbs. Locate sprinkler heads to assure proper coverage of indicated sprinkler heads to assure proper coverage if indicated areas. Do not exceed sprinkler head spacing distances indicated in the manufacturer's manual for the nozzles installed and pressure available.

C. Provide pop-up spray heads and rotary sprinklers ¾" IPS or smaller with two elbow poly swing joint riser using "funny pipe", minimum length 12".

D. Provide all rotary sprinklers, 1" IPS, with pre-fabricated three elbow swing joint, schedule 80 PVC.

E. Fittings and pre-fabricated swing joint manufacturers shall be Spears, Lasco, or Dura.

3.6 VALVE INSTALLATION:

A. All zone control valves, quick coupler valves, and manual valves shall be enclosed in a minimum 11" x 14" valve box. Add extensions as required to prevent soil settlement around the valve. Set box flush with finish grade and aligned with adjacent boxes and/or adjoining site-work.

B. Install filter fabric inside valve box and install valve boxes on a suitable base of gravel to provide a level foundation at proper grade and to provide drainage of the access box. Support box with block or notch box to protect pipe under box.

C. Install valve drip kit, including pressure regulator and filter, for valves on drip zones. Acceptable manufacturers are Hunter, Netafim, Rainbird, or Toro.

D. Provide all quick coupler valves with pre-fabricated three elbow swing joint, schedule 80 PVC.

E. Fittings and pre-fabricated swing joint manufacturers shall be Spears, Lasco, or Dura.

3.7 BACKFLOW PREVENTER:

A. Backflow installation shall meet all applicable plumbing and health department codes.

B. All pipe to and from backflow preventers until the discharge pipe reaches 24" bury, shall be type 'L' hard copper.

C. Install air-gap discharge to floor drain.

3.8 BOOSTER PUMP (if required):

A. Pump to be in end suction, bronze fitted, self-priming, single stage centrifugal type.

B. Pump to be close coupled to a ball bearing, drip proof motor.

C. Pump casing shall be of gray iron, with bronze replaceable wear ring. Impeller to be bronze, provide with mechanical seal.

D. Pump to be mounted on 4" high concrete pad or attached to wall.

E. All pipe to and from pump shall be type ‘L’ hard copper.

F. Pump is to start/stop from control timer or from a pressure switch.

G. Booster pump shall include mercoid switch to suspend pumping operations if upstream pressure drops to 20 PSI.

H. Provide detail drawing of pump installation.

3.9 DRIPPERLINE INSTALLATION:

A. Install dripperline in accordance with manufacturers recommended installation procedures.

B. Prepare area for dripline installation by clearing soil surface of debris. Layout dripline in 12” rows in groundcover and annual beds. Layout drip lines for hedges using one line on both sides of hedge. Stake dripline to prevent movement.

C. All dripperline shall be installed on grade but below mulch.

D. Install header pipe on drip zones per description on sections 3.4 of these specifications.

E. Each segment of dripperline is to be installed using pressure and exhaust PVC header pipe. “Snaking” of tubing back and forth throughout bed will not be accepted.

F. Valves for dripperline zones shall be drip kits complete with valve, pressure regulator and filter as are to be by the same manufacturer as the dripperline. Install inside 11” x 14” valve box.

G. Submit detail to Owner’s Representative and Landscape Architect for all pots or hanging baskets.

3.10 DRAINS:

A. Although it is intended that some systems will be winterized using compressed air. The Contractor to install manual drain valves at low points in the system to assist in winterization and service.

3.11 ELECTRICAL AND CONTROLLER INSTALLATION:

A. Install electrical control wire and two-wire cable in the piping trenches wherever possible. Place wire or cable in trench adjacent to or underneath mainlines but not above. Install wire with slack to allow for thermal expansion and contraction. Expansion joints in wire may be provided at 200 foot intervals by making 5-6 turns of the wire around a piece of 1/2" pipe instead of slack. Where necessary to run wire or cable in a separate trench, provide a minimum cover of 24".

B. Provide minimum 24" slack at remote control valves and at all wire splices to allow raising the valve bonnet or splice to the surface without disconnecting the wires for repair.

C. Connect each remote control valve to one station of a controller except as otherwise indicated. Where there is to be more than one valve per station, make required splice at the control timer.

D. Make splices only at valves, unless otherwise unavoidable. Locate all field splices on the as-built drawing.

E. For two-wire systems, ground cable at each valve location and every 600' as recommended by the manufacturer.

F. Hard wire 110 volt power to controller. All connections and installations shall meet applicable electrical codes. All wire not buried to be installed in conduit.

G. Connect data line, cellular, radio, or phone line to controller and test for successful communication link.

H. Accurately label zones inside the controller. Include color sketch of approximate zone limits.

I. Connect and operate hand held remote to confirm successful valve actuation.

3.12 FLUSHING AND TESTING:

A. After all new sprinkler piping and risers are in place and connected for a given section and all necessary division work has be completed, and prior to the installation of sprinkler heads, all control valves shall be opened and a full head of water used to flush out the system.

B. Sprinkler main shall be tested under normal water pressure for a period of 12 hours. If leaks occur, repair and repeat the test. Give Architect 24 hours notice prior to testing.

C. Testing of the system shall be performed after completion of each section or completion of the entire installation; and any necessary repairs shall be made, at the Contractor's expense, to put the system in good working order before final payment by the Owner.

D. Adjustment of the sprinkler heads and automatic equipment will be done by the Contractor upon completion of installation to provide optimum performance. Minor adjustments during the guarantee period will be made by the Owner.

3.13 CLEAN UP:

A. The Contractor shall keep the premises free from rubbish and debris at all times and shall arrange his material storage so as not to interfere with the Owner's operation of the job. The Contractor shall remove and legally dispose of all unused material, rubbish and debris, including unsuitable excavated material from the site.

END OF SECTION 328400

SECTION 329119 - TOPSOIL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, General and Supplemental Requirements, which are hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of Topsoil Work is shown on drawings and by provisions of this Section.

B. Types of work required include the following:

1. Laboratory testing of soil
   a. Existing – refer to Section 1.4, C
   b. Imported topsoil
2. Topsoil source (imported)
3. Installation
4. Cleaning

C. Related Work Specified Elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 PROJECT CONDITIONS:

A. Known underground and surface utility lines are indicated on the drawings.

B. Protect existing trees, plants, lawns and other features designated to remain as part of the landscaping work.

C. Promptly repair damage to adjacent facilities caused by topsoil operations. Cost of repair shall be at the Contractor's expense.

D. Promptly notify the Owner’s Representative and Landscape Architect of unexpected sub-surface conditions.

1.4 QUALITY ASSURANCE:

A. Testing and Inspection: For supplied topsoil. Performed by a qualified independent testing laboratory, under the supervision of a Registered Professional Engineer, specializing in soils engineering.

B. Provide and pay for testing and inspection during topsoil operations. Laboratory shall be acceptable to the Owner’s Representative and Landscape Architect.

1. Recommended Testing Laboratory:
   A & L Great Lakes Laboratories, Inc.
   3505 Conestoga Drive
   Fort Wayne, IN 46808
   P: (260) 483-4759
   F: (260) 483-5274
   www.algreatlakes.com

C. The Contractor shall provide up to (5) five existing soil sample tests from across the project site to provide a clear understanding of existing soil conditions and inform fertilizer recommendations for proposed planting. Locations of the soil samples shall be at the Owner's Representative and Landscape Architect's discretion. Samples shall not include plant material growth or root systems from existing material, and shall be from the top 12" of existing grade. Existing soil tests shall conform to the requirements outlined below in Section 1.5 and shall be at the Contractor's expense.

1.5 SUBMITTALS:

A. Tests of representative material samples for proposed use shall include:

1. Soil pH and Buffer pH
2. Available phosphorus
3. Mechanical analysis (P.K. Ca. mg) and cation ratios
4. Percentage of organic content and loss by ignition
5. Soil series classification
6. Sand, Silt and Clay content ratios
7. Soluble salts and sodium
8. Cation exchange capacity (CEC)
9. Herbicide multi-residue test (MR-1) required if topsoil from agricultural source
10. Lime/Sulfur requirements

B. Provide soil lab recommendations of fertilizer requirements and ratios for both ornamental plantings and turf lawn.

C. Provide soil lab recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring soil nutrients to a satisfactory level for ornamental planting and turf lawn.

D. Provide soil lab recommendations regarding residue test results if applicable.

E. Submit test reports in a timely manner so that topsoil testing results are approved prior to beginning topsoiling work.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Topsoil: Topsoil proposed for use must meet testing criteria results specified and conform to adjustments as recommended by soil test and Landscape Architect.

B. Provide lightly screened topsoil as required to complete the job. Topsoil should not be screened to the effect that the end product has a fine particle composition and is highly compactable. All processing, cleaning and preparation of topsoil to render it acceptable for use is the responsibility of the Contractor.

C. Topsoil shall be fertile, friable and representative of local productive soil, capable of sustaining vigorous plant growth and lightly screened free of clay lumps, subsoil, noxious seeds, weeds or other foreign matter such as stones, roots, sticks and other extraneous materials greater than 1" in diameter in any dimension and shall not be frozen or muddy.

1. Existing and supplied topsoil shall have the following charicteristics:
   a. pH shall range between 5.0 and 7.5.
   b. Organic matter shall range between 3 and 10 percent.

c. Soluable salts shall be less than 1.6 mmho/cm.
d. Sand content shall range between 65 and 75 percent.
e. Silt content shall range between 10 and 20 percent.
f. Clay content as determined by Bouyoucous Hydrometer Test shall range between 5 and 15 percent.
g. CEC should range between 5 and 12.
h. The topsoil shall be classified as a sandy loam topsoil.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine rough grades and installation conditions. Do not start topsoil work until unsatisfactory conditions are corrected.

3.2 INSTALLATION:

A. Perform topsoiling within contract limits, including adjacent transition areas, to new elevations, levels, profiles, and contours indicated. Provide uniform levels and slopes between new elevations and existing grades.

B. Grade surfaces to assure areas drain away from building structures and to prevent ponding and pockets of surface drainage.

C. Lawn Areas: Supply and spread topsoil to a minimum uniform depth of 4” or as noted. Remove clumps larger than 1” in diameter.

D. Grade lawn areas to a smooth, free draining even surface with a loose, moderately coarse texture ready to accept seed or sod.

E. For trees, shrubs, ground cover beds and backfill for beds see Section 329300 – Plants.

F. Provide earth crowning where indicated on drawings.

G. Crowning/mounding to be free flowing in shape and design, as indicated, and to blend into existing grades gradually so that toe of slope is not readily visible. Owner’s Representative and Landscape Architect to verify final contouring before planting.

H. Regardless of finish grading elevations indicated, it is intended that grading be such that proper drainage of surface water will occur and that no low areas are created to allow ponding. Contractor to consult with Owner’s Representative and Landscape Architect regarding minor variations in grade elevations before rough grading is completed.

I. Landscape areas to receive topsoil should not be compacted more than 80%-85%.

3.3 CLEANING:

A. Upon completion of topsoiling operations, clean areas within contract limits, remove tools and equipment. Site shall be clear, clean, free of debris and suitable for site work operations.

END OF SECTION 329119

SECTION 329219 - SEEDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Requirements, which are hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of seeded lawns is shown on drawings and by provision of this section.

B. Type of work required includes the following:

1. Soil preparation
2. Seed Installation
3. Hydromulching
4. Erosion straw blankets (as required)
5. Establishment
6. Cleaning

C. Related work specified elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 SUBMITTALS:

A. Seed vendor's certification for required grass seed mixture, indicating percentage by weight and percentages of purity, germination and weed seed for each grass species.

B. Erosion control blanket manufacturer data sheets, including anchoring.

C. Fertilizer manufacturer data sheets.

D. Hydromulching manufacturer data sheets.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Deliver seed and fertilizer materials in original unopened containers, showing weight, analysis and name of manufacturer. Store in a manner to prevent wetting and deterioration.

1.5 PROJECT CONDITIONS:

A. General:

1. The Contractor shall examine and verify the acceptability of the job site. Notify Owner’s Representative and Landscape Architect if conditions detrimental to plant growth are encountered such as rubble fill, adverse drainage conditions or obstructions. Do not proceed with the work until unsatisfactory conditions have been corrected or resolved in writing by the Owner’s Representative and Landscape Architect.
2. Where seeding occurs in close proximity to other site improvements or areas to remain undisturbed such as existing wetlands and upland areas care shall be taken to not disturb the existing conditions. Any areas damaged during planting operations shall be promptly restored to their original condition at no cost to the Owner.

3. Work Notification: Notify Owner's Representative and Landscape Architect at least 7 working days prior to start of seeding operation.
4. Protect existing utilities, paving and other facilities from damage caused by seeding operations.
5. Perform seeding work only after planting and other work affecting ground surface has been completed.
6. Restrict traffic from lawn areas until grass is established. Erect signs and barriers as required.
7. Provide hose and lawn watering equipment as required for germination and establishment.
8. If an irrigation system is to be installed per the contract drawings, it shall be installed prior to seeding. Locate, protect and maintain the irrigation system during seeding operations. Repair irrigation system components damaged during seeding operations at the Contractor's expense.

1.6 WARRANTY:

A. Refer to Section 320536 – Landscape Maintenance and Warranty Standards.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Topsoil for seeded lawn areas: Refer to Section 329119 – Topsoil, and to drawings.

B. Seed: Fresh, clean and new crop seed mixture. Mixed by approved methods.

C. Composed of the following varieties, mixed to the specified proportions by weight and tested to minimum percentages of purity and germination.

D. Jacklin seed products manufactured by Simplot. www.simplot.com, distributed by Harrell's. www.harrells.com

E. Seed Mixture: Proportioned by weight as indicated below:

Harrells Elite Sunny Mix (Lawns only)			
Revenge, Accent II Per. Ryegrass	35%	95%	80%
Aruba creeping red fescue	35%	95%	80%
Bluechip Plus, NuBlue Plus Ky. Bluegrass	30%	95%	80%

Seeding rate of 4-5 lbs./1,000 sf

No noxious weed seeds permitted.

F. Fertilizer: Use a 1-2-1 NPK ratio SGN 100-210 starter fertilizer that is non injurious to turf seedlings with a controlled release of nitrogen to provide 10-16 week of fertility for optimum turf growth. Nitrogen not to be affected by rainfall or irrigation. Phosphorus and potassium amendments shall be industry standards. If soil test results show adequate phosphorus and potassium then NPK ration shall be amended to 3-0-2 (see 3.2F for application rates)

G. Ground limestone: Used if required by soil test report. Containing not less than 85% of total carbonates and ground to such fineness that 50% will pass through a 100 mesh sieve and 90% will pass through a 20% mesh sieve.

H. Granulated sulfur 0-0-0-90 to lower PH. Use if determined by soil tests to be necessary. Apply per soil test recommendations at specified rate.

I. Water: Free of substance harmful to seed growth. Hoses or other methods of transportation furnished by the Contractor. Test for excess Alkalinity, if necessary.

J. Hydromulch: Degradable green dyed wood cellulose fiber or 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination, water and wildlife and suitable to hydromulching.

1. Available manufacturer and product, or approved equal:
   a. Profile Products LLC, Buffalo Grove, IL
      1) Profile HM Wood w/ Tack for slopes less than or equal to 3H:1V
      2) ProMatrix EFM/BFM for slopes less than or equal to 2H:1V
      3) Flexterra HP-FGM for slopes less than or equal to 0.25H:1V

K. Biodegradable erosion control blanket: 100% organic, weed seed free fibers, single stitched into a photodegradable white netting. Acceptable manufacturer: American Excelsior – Curlex I or approved substitute.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Owner's Representative and Landscape Architect must approve finish surfaces, grades, topsoil quality and depth. Do not start seeding work until unsatisfactory conditions are corrected.

3.2 PREPARATION OF SEEDED LAWN AREAS:

A. Limit preparation to areas which will be immediately seeded.

B. Treat lawn areas if required with "Round Up" by Monsanto, per label directions to kill existing vegetation prior to seeding.

C. Loosen topsoil of lawn areas to minimum depth of 4". Remove stones over 1" in any dimension and sticks, roots, rubbish and extraneous matter.

D. Apply amendments as indicated by soil test and incorporate in top 3 inches of soil. Amended soil test results must be forwarded to the Owner's Representative and Landscape Architect.

E. Grade lawn areas to a smooth, free draining even surface with a loose, moderately coarse texture. Roll and rake, remove ridges and fill depressions as required to drain.

F. Apply starter fertilizer (meadow lawn area shall only receive fertilizer per supplier and soil test) at a rate to provide sustained fertility to seedlings of .15 - .2 lbs. N per 1,000 sf per week for 10-16 weeks or per topsoil test recommendations. Starter fertilizer may be part of phosphorus and potassium needs as indicated by soil test.

G. Apply fertilizers, thoroughly and evenly incorporated into soil to a minimum depth of 1/4" by dragging or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.

H. Restore prepared areas to specified condition if eroded, settled or otherwise disturbed after fine grading and prior to seeding.

3.3 INSTALLATION:

A. Seed lawns only between April 1 and June 1 (Meadow lawn between March 15 and May 15) and fall seeding between August 15 and October 15 or at such other times acceptable to Owner's Representative and Landscape Architect.

B. Seed immediately after preparation of soil bed. Seed indicated areas within contract limits and turf areas adjoining contract limits disturbed as a result of construction operations.

C. Perform seeding operations when the soil is dry and when winds do not exceed 5 miles per hour velocity.

D. Apply seed at a rate per seed mixture specifications. Install seed evenly by sowing equal quantities in 2 directions, at right angles to each other, to achieve 100% uniform coverage.

E. After seeding, rake or drag surface of soil lightly to incorporate seed into top 1/8" of soil. Roll with light lawn roller.

F. Acceptable means of seed distribution include rotary spreader or pull behind mechanical spreaders with cultipacker. Unless specifically noted, hydroseeding is not allowed.

3.4 HYDROMULCHING:

A. Use a hydromulcher (sprayer) and apply mixture(s) per manufacturers recommended application rates. Mix in accordance with manufacturer's recommendations.

B. Use tackifier on all erosion prone areas: steep slopes, high wind areas, drainage areas.

C. Care must be taken not to get hydromulch materials on buildings, walks, roadways, plant beds etc.

3.5 EROSION BLANKET:

A. On slopes exceeding 3H: 1V, or as shown on drawing, install erosion control blanket per manufacturer's guidelines if not using approved hydromulch for slopes.

3.6 LAWN ESTABLISHMENT:

A. Establish dense lawn of permanent grasses, free from weeds, lumps and depressions. Any area failing to show uniform germination to be reseeded; continue until dense lawn established. If seeded in fall or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established. Damage to seeded area resulting from erosion to be repaired by the Contractor. Scattered bare spots over 5 percent are not allowed or bare spots larger than a 3" x 3" area.

B. In event the Contractor does not establish dense lawn during germination period, return to project to re-fertilize and reseed to establish dense lawn.

C. The Contractor shall provide a minimum of two cuttings for acceptance of the lawn, or more as necessary until the inspection and acceptance of installation by the Owner's Representative and Landscape Architect. When the seeded turf lawn reaches 4" in height it shall be cut to 3" in height. Not more than 1/3 of the grass leaf shall be removed at any single mowing. Meadow lawn shall have seed heads cut in June and be maintained at a height of 8"-10".

D. Should the seeded lawn become largely weeds after germination, the Contractor shall be responsible to kill the weeds and reseed the proposed lawn areas to produce a dense turf, as specified at no additional cost.

3.7 MAINTENANCE:

A. Refer to section 320536 - Landscape Maintenance and Warranty Standards for additional contract requirements.

3.8 CLEANING, REMOVAL AND RESTORATION:

A. All areas over which hauling operations have been conducted shall be kept clean on a daily basis. Promptly remove materials spilled on pavement.

B. Upon completion of seed installation, remove from the site and legally dispose of all trash and debris including any material removed during grade preparation.

C. Restore existing areas damaged by operations under the contract. Restoration shall include finish grading and seeding as required to match existing grade and/or wetlands, and maintenance of restored areas.

D. Any damage by the Contractor to established or newly seeded areas not within the project scope of work shall be repaired and reseeded at no cost to the Owner.

E. Repair damage resulting from seeding operations. Clean all areas where overspray has occurred from hydromulching or hydroseeding operations.

END OF SECTION 329219

SECTION 329223 – SODDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of sodded lawns is shown on drawings and by provisions of this Section.

B. Type of Work Required Includes the Following:

1. Soil preparation
2. Sodding lawns
3. Establishment
4. Cleaning

C. Related Work Specified Elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 SUBMITTALS:

A. Sod grower's certification of grass species including special shade grown species. Identify source location.

B. Fertilizer manufacturer data sheets.

C. Grower's soil analysis or certification stating mineral / topsoil grown sod.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Cut, deliver and install sod within 24-hour period.

B. Do not harvest or transport sod when moisture content may adversely affect sod survival.

C. Protect sod from sun, wind and dehydration prior to installation. Do not tear, stretch or drop sod during handling and installation.

1.5 PROJECT CONDITIONS:

A. General:

1. Contractor shall examine and verify the acceptability of the job site. Notify the Owner's Representative and Landscape Architect if conditions detrimental to plant growth are encountered such as rubble fill, adverse drainage conditions or obstructions. Do not proceed with the work until unsatisfactory conditions have been corrected or resolved in writing by the Owner's Representative and Landscape Architect.
2. Where sodding occurs in close proximity to other site improvements or areas to remain undisturbed such as existing wetlands and upland areas care shall be taken to not disturb

the existing conditions. Any areas damaged during planting operations shall be promptly restored to their original condition at no cost to the Owner.

3. Work Notification: Notify the Owner's Representative and Landscape Architect at least 7 working days prior to start of sodding operation.
4. Protect existing utilities, paving and other facilities from damage caused by sodding operations.
5. Perform sodding work only after planting and other work affecting ground surface has been completed.
6. Restrict traffic from lawn areas until sodded lawn is established and rooted in. Erect signs and barriers as required.
7. The irrigation system will be installed prior to sodding. Locate, protect and maintain the irrigation system during sodding operations. Repair irrigation system components damaged during sodding operations at the Contractor's expense.

1.6 QUALITY ASSURANCE:

A. Sod: Comply with American Sod Producers Association (ASPA) classes of sod materials.

1.7 WARRANTY:

A. Refer to Section 320536 – Landscape Maintenance and Warranty Standards.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Sod: An "approved" nursery turfgrass sod blend of improved Kentucky Blue-grass varieties.

1. Sod containing Common Bermudagrass, Quackgrass, Johnsongrass, Poison Ivy, Nutsedge, Nimblewill, Canada Thistle, Timothy, Bentgrass, Wild Garlic, Ground Ivy, Perennial Sorrel or Bramegrass weeds will not be acceptable.

B. Provide premium grade well-rooted, healthy sandy-loam topsoil grown turfgrass sod, (submit grower and soil analysis for review). Sod shall be free of diseases, nematodes and soil borne insects. Peat grown sod is not acceptable. Provide sod uniform in color, leaf texture, density and free of weeds, undesirable grasses, stones, roots, less than ½" thatch and extraneous material; viable and capable of growth and development when planted.

C. Furnish turfgrass sod, machine cut in square pads or strips not more than 3'-0" long; with uniform soil thickness of 0.6 inch plus or minus .25 inch at time of cutting with clean-cut edges. Measurement for thickness shall exclude top growth and thatch. Mow sod before stripping at uniform height of 1 to 2.5 inches. Big roll sod is acceptable.

D. Fertilizer: Fertilizer ratio shall be per topsoil testing lab recommendations. Phosphorus and potassium amendments shall be industry standard. If soil test results show adequate phosphorus and potassium then NPK ratio shall be amended to 3-0-2. (see 3.2, F for application rates).

E. Ground Limestone: Containing not less than 85% of total carbonates and ground to such fineness that 50% will pass through a 100 mesh sieve and 90% will pass through a 20 mesh sieve. Use if determined by soil tests to be necessary.

F. Stakes: Softwood, 3/4" x 8" long.

G. Water: Free of substance harmful to sod growth. Hoses or other methods of transportation furnished by the Contractor. Test for excess alkalinity, if necessary.

H. Topsoil: Refer to Section 329119 – Topsoil.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine finish surfaces, grades, topsoil quality and depth. Do not start sodding work until unsatisfactory conditions are corrected.

3.2 PREPARATION:

A. Limit preparation to areas which will be immediately sodded. Spread topsoil, fine grade.

B. Treat lawn areas with "Round Up" by Monsanto, per label directions as required to kill existing vegetation prior to sodding.

C. Spread and loosen topsoil on lawn areas to minimum depth of 4". Remove stones over 1" in any dimension and sticks, roots, rubbish and extraneous matter. (In athletic fields remove stones over 1/4” in any dimension. Refer to Section 329119 – Topsoil.)

D. Grade lawn areas to smooth, free draining and even surface with a loose, and uniformly fine texture. Roll and rake; remove ridges and fill depressions as required to drain.

E. Apply amendments as indicated by soil test, with rotary spreader and incorporate in top 3 inches of soil. Soil test results must be forwarded to the Owner’s Representative and Landscape Architect.

F. Apply fertilizer as indicated on soil test or at a rate to provide sustained fertility of .15 - .2 lbs. N per 1000 sf per week for 10-16 weeks or per soil test recommendations. Fertilizer may be part of phosphorus and potassium needs as indicated by soil test.

G. Dampen dry soil prior to sodding.

H. Restore prepared area to specified condition if eroded, settled or otherwise disturbed after fine grading and prior to sodding.

3.3 INSTALLATION:

A. Do not lay dormant sod or install sod on saturated or frozen soil. Moistening the soil: During periods of higher than optimal temperature for the species being specified, and after all enevenness in the soil surface has been corrected, the soil shall be lightly moistened immediately prior to installation of the turfgrass sod.

B. Install initial row of sod in a straight line, beginning at bottom of slopes, perpendicular to direction of the sloped area. Place subsequent rows parallel to and lightly against previously installed row.

C. Lay sod to form a solid mass with tightly-fitted joints. Butt ends and sides of sod strips. Do not overlay edges. Stagger strips to offset joints in adjacent course. Remove excess sod to avoid

smothering of adjacent grass. Provide sod pad top flush with adjacent curbs, sidewalks, drains and seeded areas.

D. Peg sod on slopes greater than 3 to 1 to prevent slippage at a rate of 2 stakes per yard of sod.

E. Water sod thoroughly with a fine spray immediately after laying.

F. Roll with light lawn roller to ensure contact with sub-grade.

G. Sod indicated areas within contract limits and repair areas adjoining contract limits disturbed as a result of construction operations with sod or to original condition, as approved by Owner.

3.4 SOD ESTABLISHMENT:

A. Maintain sodded lawn areas, including watering, fertilizing, spot weeding, mowing, application of herbicides, fungicides, insecticides, and re-sodding until a full, uniform stand of sod is knit¬ted to topsoil.

B. Mow lawn areas as soon as lawn top growth reaches a 4" height. Cut back to 3" height. Repeat mowing as required to maintain specified height. Not more than 33% of grass leaf shall be removed at any single mowing. Minimum of two cuttings are required for acceptance.

C. Sodded areas will be acceptable provided all requirements, in¬cluding maintenance, have been complied with, and a healthy, even colored viable lawn is established, free of weed, undesirable grass species, disease, and insects.

3.5 MAINTENANCE:

A. Refer to Section 320536 – Landscape Maintenance and Warranty Standards for additional contract requirements.

3.6 CLEANING:

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site and legally dispose of all excess materials, debris and equipment. Repair damage resulting from sodding operations.

END OF SECTION 329223

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of trees, shrubs and ground covers is shown on drawing and by provisions of this Section.

B. Type of Work Required Includes the Following:

1. Planting backfill tests
2. Compost tests
3. Soil percolation, moisture, and soil compaction testing
4. Soil preparation
5. Planting mixes
6. Plant materials
7. Plant material installation
8. Backfill and planting accessories, watering, mulching, staking/guying
9. Pruning
10. Cleaning
11. Maintenance and Warranty

C. Related Work Specified Elsewhere: Refer to the entire project manual for additional contract requirements.

1.3 SUBMITTALS:

A. See the contract General Conditions for policy and procedures related to submittals.

B. Submit all product submittals immediately after contract award.

C. Product data and certificates: For each type of manufactured product, submit data and certificates that the product meets the specification requirements, and complying with the following:

1. Submit manufacturers or supplier's product data and literature certified analysis for standard products and bulk materials, complying with testing requirements and referenced standards and specific requested testing.

a. For Compost product submit the following analysis by a recognized laboratory:

1.) pH
2.) Salt concentration (electrical conductivity)
3.) Moisture content %, wet weight basis
4.) Particle size % passing a selected mesh size, dry weight basis
5.) Stability carbon dioxide evolution rate mg CO_2-C per g OM per day
6.) Solvita maturity test
7.) Physical contaminants (inerts) %, dry weight basis

8.) US EPA Class A standard, 40CFR § 503.13, Tables 1 and 3 levels Chemical Contaminants mg/kg (ppm)

b. For imported and stockpiled topsoil; refer to Specification Section 329119: Topsoil.

c. For planting backfill mix type 'A', submit the following analysis by a recognized laboratory:

1.) pH factor
2.) Mechanical analysis (P, K, Ca, Mg) and Cation ratios
3.) Percentage of organic content and loss by ignition
4.) Fertilizer recommendation for ornamental plants based on laboratory analysis

d. If tests fail to meet the specifications, obtain other sources of material, or amend and retest and resubmit until accepted by the Owner's Representative and Landscape Architect.

e. All soil testing will be at the expense of the Contractor.

f. Submit materials certification for all fertilizer products as recommended by the soil tests.

g. Submit product data sheets for all planting accessories and pre-manufactured backfill mixes (Types 'C' and 'D') proposed to be used.

D. Submit labeled samples of the following:

1. One (1) quart bag of double processed shredded bark mulch.
2. One (1) quart bag of planting backfill mix Type A.

E. Plants must be approved prior to shipping to the site.

1. Photographs of representative material. Each submitted image shall have a height and width reference, such as a measuring stick or ruler and shall have dimensions visible in the photos. Plants not meeting the quality of approved representative sample will be rejected.

F. Submit planting pit percolation results.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Deliver fertilizer materials in original, unopened and undamaged containers showing weight, analysis and name of manufacturer. Store in manner to prevent wetting and deterioration.

B. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Transport and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice or order to stock and on arrival. A copy of certificate shall be filed with the Owner's Representative and Landscape Architect. Protect all plants from drying out. If plants cannot be planted immediately upon delivery, properly protect them with soil, wet peat moss or in a manner acceptable to the Landscape Architect. Contractor to confirm root ball moisture levels are acceptable with moisture meter. Refer to Section 3.3.D.3. Water heeled-in plantings as required to keep root system moist until planting. No plant shall be bound with rope or wire in a manner that could damage or break the branches.

C. Cover plants transported on open vehicles with a protective covering to prevent windburn.

D. Frozen or muddy backfill mixture is not acceptable.

E. If Honey locust trees are specified for the project, the Contractor shall ensure that canopy branching is loosely tied at the grower or nursery to prevent damage to the branching structure during shipping and handling.

1.5 PROJECT CONDITIONS:

A. Work Notification: Notify the Owner's Representative and Landscape Architect at least 10 working days prior to installation of plant material.

B. Protect existing utilities, paving and other facilities from damage caused by landscaping operations. Contractor to contact Miss Dig prior to any digging operations. See AIA General Conditions.

C. A complete list of plants, including a schedule of sizes, quantities and other requirements is shown on the contract documents. In the event that quantity discrepancies or material omissions occur in the proposal form, the Contractor shall notify the Owner's Representative and Landscape Architect during the proposal bidding process.

D. It is the responsibility of the Contractor to be familiar with the local growing conditions. If any specified plants will be in conflict with these conditions, report any potential conflicts, in writing, to the Owner's Representative and Landscape Architect.

E. If an irrigation system is to be installed per the contract drawings, it shall be installed prior to planting. Locate, protect and maintain the irrigation system during planting operations. Repair irrigation system components damaged during planting operations at the Contractor's expense.

F. Verify availability of on-site water.

G. Concealed contingencies. Refer to AIA General Conditions.

H. Maintain grade stakes set by others until parties affected mutually agree upon removal.

I. Repair all damage caused by planting operations.

1.6 QUALITY ASSURANCE:

A. The Contractor shall provide soil tests for a clear understanding of soil conditions and inform fertilizer recommendations for proposed planting as outlined in Section 329119 - Topsoil.

B. Planting shall be performed only by experienced workers familiar with planting procedures and under the supervision of a qualified supervisor.

C. Plant names indicated; comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.

D. Comply with root ball sizing and grading standards of the latest edition of "American Standard for Nursery Stock." A plant shall be dimensioned as it stands in its natural position.

E. All plants shall come from nurseries located in Zones 3 – 6A of the USDA Hardiness Zone Map unless approved by the Owner's Representative and Landscape Architect.

F. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work.

G. Pruning practices shall conform to recommendations "Structural Pruning: A Guide For The Green Industry" most current edition; published by Urban Tree Foundation, Visalia, California.

1.7 PERMITS AND REGULATIONS

A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all laws and ordinances bearing on the operation or conduct of the work as drawn and specified. If the Contractor observes that a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner's Representative and Landscape Architect in writing including a description of any necessary changes and changes to the contract price resulting from changes in the work.

B. Wherever references are made to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.

C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply or Owner's Representative and Landscape Architect shall determine which shall govern.

1.8 MAINTENANCE AND WARRANTY:

A. Refer to Section 320536 – Landscape Maintenance and Warranty Standards.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Plants - General: Provide plants typical of their species or variety; with densely developed branches and vigorous, fibrous root systems free of insects and diseases and have a fully developed form without voids and open spaces. Plants shall be lush, without dry foliage or root balls, free of defects, disfiguring knots, sunscald, wind burn, broken branches, frost cracks or abrasions.

1. All plants shall meet the requirements for caliper, spread and height indicated on the contract drawings or within the project manual. Plants larger than those specified may be used if acceptable to Owner's Representative and Landscape Architect.
2. Balled and burlapped plants shall have clay, clay loam, or sandy loam balls of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Beach sand or loose sand root balls are not acceptable. Root balls which crumble or do not hold together on their own when burlap is pulled down will be rejected.
3. Provide root ball sizes complying with the latest edition of the "American Standard for Nursery Stock" latest edition.
4. Cracked or mushroomed balls will not be accepted.
5. No pruning wounds shall be present with a diameter of more than 1" and all pruning wounds must show vigorous bark on all edges.

6. Plants shall not have root bound, circular or girdled root systems.

B. All trees shall have straight trunks and crowns of healthy condition as follows:

1. Trees must have one straight central leader through crown of tree, unless a different form is inherent in that species and is approved by the Landscape Architect during the submittal process.
2. “V” crotch branching will not be accepted.
3. Tree crown shall be uniform, full without “holes” or missing branch structure, symmetrical, plumb and characteristic of species.
4. Evergreen trees shall be considered either natural or lightly sheared, fully branched to ground and shall have a shearing designation Type ‘N’ or ‘LS’ as set forth in the “American Standard for Nursery Stock” latest edition.
5. The tree trunk shall be straight, vertical, and free of wounds that penetrate to the wood with properly made cuts. Sunburned areas, conks (fungal fruiting bodies), wood cracks, sap leakage, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury) are not acceptable and are cause for rejection.

C. Specimen Stock: All specimen designated plantings are to be nursery grown, fully developed, meeting or exceeding specified size and associated root ball sizes per the “American Standard for Nursery Stock” latest edition, exceed quality standards set forth above, and be of excellent quality and exceptional examples of the species. Plants designated to be planted in rows must be matched, symmetrical and uniform in height, spread, caliper, branching height and crown density.

1. Matched plantings shall be obtained from same nursery and, preferably, from same row or line.
2. Landscape Contractor to tag specimen trees or shrubs at the source of supply. The Landscape Architect may inspect specimen selections at the source of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally, the Contractor shall provide sufficient photographs of the proposed specimen plants for approval. The Landscape Contractor shall inspect all plant material at source prior to Landscape Architect’s review. Landscape Contractor shall accompany Landscape Architect to nursery on final selection trip (if required).

D. Container-Grown Stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.

1. No plants shall be loose in the container.
2. Container stock shall not be root bound.
3. The measurements for height shall be taken from the ground level to the average height of the top of the plant and not the longest branch as per the American Standard for Nursery Stock.
4. Single stemmed or thin plants will not be accepted.
5. Side branches shall be generous, well twigged and the plant as a whole shall be well branched to the ground.
6. Plants shall be in a moist, vigorous condition, free from dead wood, bruises or other root or branch injuries.

E. Topsoil for Planting Mix: Refer to Section 329119 - Topsoil.

F. Compost: Blended and ground leaf, wood and other plant based material, composted for a minimum of 9 months and at temperatures sufficient to break down all woody fibers, seeds and leaf structures, free of toxic material at levels that are harmful to plants or humans. Source

material shall be yard waste trimmings blended with other plant or manure based material designed to produce Compost high in fungal material.

1. Compost shall be commercially prepared Compost and meet US Compost Council STA/TMECC criteria or as modified in this section for "Compost as a Landscape Backfill Mix Component".

    a. http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf

2. Compost shall comply with the following parameters:

    a. pH: 5.5 - 8.0.
    b. Soil salt (electrical conductivity): maximum 5 dS/m (mmhos/cm).
    c. Moisture content %, wet weight basis: 30 – 60.
    d. Particle size, dry weight basis: 98% pass through 3/4 inch screen or smear.
    e. Stability carbon dioxide evolution rate: mg CO2-C/ g OM/ day < 2.
    f. Solvita maturity test: > 6.
    g. Physical contaminants (inerts), %, dry weight basis: <1%.
    h. Chemical contaminants, mg/kg (ppm): meet or exceed US EPA Class A standard, 40CFR § 503.13, Tables 1 and 3 levels.
    i. Biological contaminants select pathogens fecal coliform bacteria, or salmonella, meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) level requirements.

G. Planting Mixture Type A: (for shrubs, perennials, ground covers and trees within plant beds at grade) Planting backfill shall be a mixture of 3/4 topsoil, 1/4 compost. Mix together to loosely incorporate compost into topsoil. Ensure not to over mix and do not mix with a mechanical soil blending machine. Mix by hand shovel or loader bucket. Do not screen the backfill mixture. Add fertilizer only if required and at rates indicated by soil tests. Fertilizer can be mixed into backfill or broadcast on top after installation. Follow planting details and provisions of this specification for installation instructions.

1. Planting Mix Type A shall comply with the following parameters:

    a. pH: 5.5 - 7.0
    b. Percentage of organic content and loss by ignition: 2.75 - 4% (by dry weight)
    c. Soil chemistry suitable for growing the plants specified

H. Planting Mixture Type B: (for trees in individual planting pits at grade) Planting backfill shall be a profile of 1/3 existing soil excavated from tree pit, 2/3 approved topsoil. Repurposed existing soil shall not contain clumps of organic material from existing finish grade (i.e. lawn / plants / roots). Add fertilizer only if required, at rates indicated by soil tests and at the direction of the Landscape Architect. Follow planting details and provisions of this specification for installation instructions.

I. Planting Mixture Type C: (for annuals, perennial, shrubs, ground cover, and ornamental grasses in pots or containers) Planting backfill shall be "Premium All Purpose Potting Soil" manufactured by Proven Winners, www.provenwinners.com or approved equal. Do not add fertilizer to backfill mix.

J. Plant fertilizer with micronutrients shall be applied only per soil test recommendations, at the direction of the Owner's Representative and Landscape Architect, and shall be:

1. Legal and acceptable in the local community of the project and shall not be harmful to the public or wildlife when applied per manufacturer's instructions.
2. Controlled-release, SCU or IBDU fertilizers for plant beds and deep-root feeding shall be used unless approved otherwise.
3. Tree and plant fertilizer used shall contain low or no phosphate unless soil tests indicate soil is deficient in this nutrient.

K. "MyCor" PHC Tree Saver Soil Conditioner manufactured by Plant Health Care, Inc., (800) 421-9051, shall be applied only if indicated on soil test recommendations or if instructed by the Landscape Architect.

L. Elemental Sulfur: Use to lower soil pH only under the direction of the Landscape Architect or based upon the soil test report.

M. Lime:

1. Use to increase soil pH only, under direction of Landscape Architect or based upon soil test report.
2. ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

   a. Class: Class T, with a minimum 99 percent passing through No. 8 (2.36-mm) sieve and a minimum 75 percent passing through No. 60 (0.25-mm) sieve.
   b. Provide lime in form of dolomitic limestone.

3. Provide manufacturer's literature and material certification that the product meets the requirements.

N. Anti-Dessicant: Protective natural polymer film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

   a. Bonide: Wilt Stop
   b. SavATree: ArborGuard
   c. Wilt Pruf

O. Double Processed Shredded Bark Mulch: Dark brown in color, clean, free of debris and sticks, and well aerated. Materials shall be uniform in size, shape and texture. Recycled wood products, such as "pallet mulch," shall not be used. Submit samples for approval prior to installation.

P. Water: Free of substances harmful to plant growth. Hoses or other methods of transportation furnished by the Contractor.

Q. Stakes for Staking: Untreated hardwood, 2" x 2" x 6'-0" minimum length.

R. Stakes for Guying: Untreated hardwood, 2 x 4 nominal, x 24" length, pointed on one end.

S. Guying/Staking Fabric: Polypropylene (ArborTie Green), available from www.deeproot.com.

T. Tree Wrap: Commercial grade, light colored, 3” wide, biodegradable, waterproof with ability to stretch to conform to surfaces.

U. Twine: Two-ply biodegradable jute material.

V. Pre-Emergent: Extended Control Weed Preventer manufactured by Preen.

W. Aluminum Edging: 3/16” x 4” extruded-aluminum edging with loops pressed from face to receive 18” long aluminum stakes.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. BRICKSTOP Co.
   b. Curv-Rite, Inc.
   c. Permaloc Co.
   d. Sure-Loc Edging Co.

2. Color and Finish: Natural
3. Install per manufacturer’s recommendations. Top to be flush with finish grade, alignment per drawings. All edging to be new.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine proposed planting areas and conditions of areas for installation. Do not start planting work until unsatisfactory conditions are corrected.

B. Provide percolation testing by filling 12” dia x 12” depth plant pits with water, refilling pit after all water has drained and monitoring length of time for water to completely percolate into soil. If pits do not drain at 1” per hour minimum or drain faster than 3” per hour, notify Owner’s Representative and Landscape Architect with recommendations for remedy.

C. Verify soil compaction in all planting areas and ensure compaction does not exceed 80%-85% modified proctor.

3.2 PREPARATION:

A. Time of Tree Digging:

1. Evergreen Material: Dig evergreen materials between August 15 and October 1 or in spring before new growth emerges. If project requirements require digging at other times, plants shall be watered to saturate the root balls and sprayed with anti-desiccant prior to digging operations.
2. Deciduous Material: Dig deciduous materials in a dormant condition prior to breaking bud. If deciduous trees are dug in-leaf, they shall be watered to saturate the root balls and sprayed with an anti-desiccant prior to digging operations.
3. Digging times other than those indicated must be acceptable to the Owner’s Representative and Landscape Architect.

B. Vegetation Removal:

1. Herbicide: Use Round Up (Monsanto Co.) as required to prepare areas for new planting, applied to all ground cover, evergreen and shrubbery beds and all mulch areas per manufacturer's recommendations. Clean area of all dead material after five (5) days. Reapply a second application as required.
2. Herbicides to be applied by licensed applicator as required by the State.
3. Mechanically strip all existing vegetation, including root systems from all proposed landscape areas. Excavate to the depths shown on the planting details and grading plans to accommodate new improvements.
4. Within the drip line of existing trees to remain, mechanical excavation and removal of existing materials shall be prohibited. All vegetation removal shall be by hand equipment to protect the existing root system. If excavation is required, it shall be achieved by hand equipment or compressed air jetting to protect the existing root system.

C. Individual plant locations shall be accurately staked according to the drawings with above ground brightly colored stakes clearly visible for review by Owner's Representative and Landscape Architect. Staking to be approved by the Owner's Representative and Landscape Architect before any planting pits are dug. The Owner's Representative and Landscape Architect reserves the right to adjust plant material locations to meet field conditions, without additional cost to the Owner.

D. Plant beds at grade shall be painted out with brightly colored marking paint clearly visible for review by the Owner's Representative and Landscape Architect. All bed lines are to be approved by the Owner's Representative and Landscape Architect prior to bed excavation. The Owner's Representative and Landscape Architect reserves the right to adjust bed edges to meet field conditions or to improve their functionality and or aesthetic appearance, without additional cost to the Owner, as long as the required plant material to fill the adjusted bed has not been increased.

E. If obstructions are encountered that are not indicated, do not proceed with planting operations until alternative plant locations have been selected and approved in writing by the Owner's Representative and Landscape Architect. Where location or spacing dimensions are not clearly shown, request clarification by the Owner's Representative and Landscape Architect.

F. Excavate individual circular planting pits with sloped sides, flat bottoms and sized in accordance with outlines and dimensions shown on the planting details. Planting beds shall be mass excavated with vertical sides to depth and dimensions as shown on the planting details and plans.

G. Contractor shall perform percolation testing per Section 3.1 B and provide test results to the Owner's Representative and Landscape Architect for approval before continuing planting operations. Should substrate drainage or soil conditions be encountered which would be detrimental to growth or survival of plant material, the Contractor shall notify the Owner's Representative and Landscape Architect before proceeding.

3.3 INSTALLATION:

A. Planting

1. Trees in Individual Planting Pits: (Refer to planting details)

   a. Scarify the sides of individual planting pits for deciduous and evergreen trees.
   b. Set trees in the planting pit to proper grade and alignment according to the drawings and specifications. Bottom of the root flare to be flush with adjacent finish grade.

c. Set trees upright, plumb and faced to give the best appearance or relationship to each other or adjacent structure. No filling or mulching will be permitted around trunks above the bottom of root flare.
d. Planting backfill mix Type 'B' shall be installed. Pulverize existing soil (see 2.1, H) by hand shovel and compact around base of tree for stability. Do not use frozen or muddy soils for backfilling. Ensure soil is properly compacted without any air pockets.
e. Remove burlap (top 6"-8" or top 1/3 of root ball), roping twine and wires from the tops of root balls just before the final backfilling of the tree pit. Cut and dispose of legally, do not fold down into the planting soil.
f. If the tree ball has an outer wire basket that doesn't meet the requirements of a low-rise basket, remove the top 6"-8" of the basket wires just before the final backfilling of the tree pit. Dispose of metal wires legally, do not bury into the tree pit.
g. Ensure trees do not have circling or girdling roots. Notify the Owner's Representative and Landscape Architect prior to proceeding if root ball conditions do not meet specifications or root conditions detrimental to the health of the tree are present.
h. Install approved topsoil over existing soil fill. Do not use frozen or muddy soils for backfilling.
i. After trees are plumbed and backfill is installed, muddle backfill mixture around sides and base of root balls and fill all voids. Sufficiently compact to prevent settlement.
j. Form a ring of soil around the edge of each planting pit to retain water in non-irrigated areas.

2. Trees, Shrubs, Ornamental Grasses, Ground covers, Perennials: (Refer to planting details)

a. Scarify the sides of mass planting beds.
b. Backfill entire bed with approved pre-mixed planting backfill mix Type 'A'.
c. Space plants in accordance with indicated dimensions. Adjust spacing as necessary to evenly fill planting bed with indicated quantity of plants.
d. Ensure container grown plants are not root bound. Lightly separate root system by hand prior to setting plants into their final position to loosen roots and stimulate lateral root growth. Ensure root system is not damaged during this process and that root balls remain intact.
e. Plant shrubs, ornamental grasses, ground covers and perennials to the edge of tree root balls, and to within 6" of the edge of plant bed, or as directed on the drawings.
f. Install trees within planting beds as outlined in Section 3.3,a,1,b,c,e,f,g and i.

B. Watering:

1. Water all trees and plants as required immediately after planting to achieve the proper soil moisture levels using a moisture meter.

a. Volumetric soil moisture level, in both the planting soil and the root balls of all plants, prior to, during and after planting shall be above permanent wilting point and below field capacity for each type of soil texture within the following ranges.

Soil type	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5-8%	12-18%

Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

1) Volumetric soil moisture shall be measured with a digital moisture meter. The meter shall be the Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent.

b. The Contractor shall confirm the soil moisture levels with a moisture meter. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

C. Mulching:w

1. Mulch planting pits and beds with required mulching material to depths per details immediately after planting and watering. Rake mulch to provide a uniform finished surface. Ensure mulch does not cover the root flare of any plant material.

D. Wrapping, Guying, Staking:

1. Inspect trees for injury to trunks, evidence of insect infestation and improper pruning before wrapping.
2. Wrap trunks of all thin skinned trees (Beech, Maple, Willow, Linden, Dogwood, Honeylocust) spirally from bottom to top with specified tree wrap and secure in place.
3. Stake/guy all trees per details before lawn seeding or sodding operations and prior to acceptance. When high winds or other conditions which may affect tree survival or appearance occur, the Contractor shall immediately stake/guy trees upon planting.

E. Pruning:

1. Prune plants only as directed by the Landscape Architect. Pruning trees shall be limited to addressing structural defects as shown in details; follow recommendations in “Structural Pruning: A Guide For the Industry” published by Urban Tree Foundation, Visalia, CA. or to remove broken branches.
2. All pruning shall be performed by a person experienced in shrub and/or structural tree pruning.
3. Remove and replace excessively pruned or malformed stock resulting from improper pruning that occurred in the nursery or after.
4. Pruning shall be done with clean, sharp tools.
5. No tree paint or sealants shall be used.

3.4 MAINTENANCE AND WARRANTY:

A. Refer to Section 320536 – Landscape Maintenance and Warranty Standards.

3.5 CLEANING:

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris and equipment.

END OF SECTION 329300

SECTION 33 05 30 – UTILITY HORIZONTAL DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the design, furnishing and installation of a pipe crossing under a street, without disturbing the surface, except at entry and exit points.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
      b. D2774 – Underground Installation of Thermoplastic Pressure Pipe.
      c. D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
      d. D3350 – Polyethylene Plastics Pipe and Fittings Materials.
      e. F1962 – Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.
   2. AWWA C906 – Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,575 mm), for Water Distribution and Transmission
   3. State DOT Current Standards:
      a. Specifications for Construction.
      b. Standard Plans.
      c. Special Provisions for Horizontal Directional Drilling.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Minimum Requirements:
   1. The requirements herein and indicated on the Drawings are minimum requirements.
   2. Product pipe shall be minimum internal diameter of 1-1/2 inches and designed to withstand a minimum internal working pressure of 70 psi at elevation 6 feet below grade with an additional minimum surge allowance of 50% of the working pressure. External pressures and loads shall not be used to offset internal design pressures.
   3. Select equipment necessary to provide the indicated finished product in the conditions present at the Site.
   4. If, in the opinion of the Contractor, additional geotechnical investigation is required for the design to define the soil conditions, the Contractor shall obtain additional geotechnical information at no cost to the Owner.
   5. No claim for unforeseen condition will be permitted.
   6. Design shall be performed by an engineer licensed in the state that the work occurs.
   7. Review of submittals by Engineer does not relieve Contractor from responsibilities under this specification.

1.5 SUBMITTALS

A. Delegated Design Action Submittals:
   1. Calculations and drawings to support and identify the pipe class, installation, thrust and tensile forces, and proposed pipe.
   2. Calculations and methods for buoyancy modifications during pull back.

3. Transition fittings at changes in pipe material.
4. Horizontal and vertical alignment drawing of the pilot hole at the same scale as the Drawings.
5. Equipment and materials staging plan, including traffic control.
6. Method for directional drill.
7. Pullback and torque capacity of drill rig(s).
8. Equipment and method for monitoring the location of the drill head.
9. Project workplan and schedule.

B. Informational Submittals:
1. Evidence of current licensure of design engineer in the state in which the work will occur,
2. Provide a log of the following information:
   a. Drill head location.
   b. Axial and torsional loads.
   c. Drilling fluid discharge rate and pressure.
3. Pipe Manufacturer material certifications.
4. Information on drilling fluids to be used.
5. For HDPE pipe, submit pipe Manufacturer's sworn and notarized statements that Contractor has been trained and certified in the handling and joining of the pipe Manufacturer’s materials.

C. Close-Out Submittals:
1. After completion of the directional drilling operation, provide an as-built drawing.
2. Drawing to Include:
   a. Scale: Same as Drawings.
   b. Tabulation of pipeline depth at 25-foot intervals referenced to a stationed alignment located above the pipe.
   c. Tabulation of horizontal alignment points at 25-foot intervals with points being either witnessed to two permanent landmarks or based upon a surveyed and documented coordinate system.

1.6 QUALITY ASSURANCE

A. Installation Personnel Qualifications:
1. Trained and experienced in the use of directional drilling equipment and installation of the materials, for the specific application of Project.
2. Knowledgeable of the design and in down hole drilling, impact of drilling in various geological formations, sensing and recording instrumentation and interpreting computer printout data.
3. Experienced in a minimum of 5 installations of similar or greater complexity and under similar conditions in the last 5 years.
4. The designated Project superintendent shall be present at the Site during work at the Site. Contractor shall not change Project superintendent without written notice to Owner a minimum of 5 working days in advance of the change. Written notice of change shall include detailed information and rationale for staffing change.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Product Pipe:
1. Allowable Pipe Materials:
   a. HDPE.
2. HDPE Pipe:
   a. Material Minimums:
      1) High density polyethylene pipe compound molecular weight of 0.941.
      2) Material Designation: PE 4710.
      3) Material Classification: Type III, Class C, Category 5, Grade P34; ASTM D1248.
      4) Cell Classification: ASTM D3350 445574C/E, PE 4710.
      5) Manufacturing Standard: ASTM D3350.
      6) Pipe shall contain no recycled compounds except that generated in the Manufacturer’s own plant from resin of the same specification from the same raw material.
   b. Manufacturers: Poly Pipe, Inc., Performance Pipe, ISCO Industries; or equal.

c. Butt fused joints using equipment and methods in strict accordance with the pipe Manufacturer's recommendations and ASTM D3261 and ASTM D2657.
d. HDPE Fittings:
    1) ASTM D3261.
    2) Molded or fabricated from polyethylene compound having a cell classification equal to or exceeding the cell classification of the pipe.
    3) Molded Fittings: Pressure rated to match the pipe SDR pressure rating to which they are connected.
    4) Fabricated Fittings:
        a) Made from pipe with a pressure rating at least 25% greater than the pipe to which they are connected.
        b) Angle of bends to have tolerance of ± 1% of required angle.
e. Pipe Joining:
    1) Pipe to Fitting Joining: Butt fused using equipment and methods in strict accordance with the pipe Manufacturer's recommendations.
    2) Joining Segments of Fabricated Fittings: Butt fused using equipment and methods in strict accordance with the pipe Manufacturer's recommendations.
f. Transitions from HDPE Pipe to Other Materials:
    1) AWWA C906.
    2) Mechanical joint adapter.
    3) Flanged joint adapter.
    4) Obtain Engineer's review.
    5) Manufacturers: Phillips Driscopipe, Inc.; Chevron Chemical Company; Plexco; or equal.

3. Product Pipeline Design: Based on Site conditions, performance criteria, and Contractor's means and methods.
4. Entire pipe line shall meet the same design requirements. Pipe segments with different design criteria will not be allowed without written approval of the Engineer and Owner.

B. Drilling Fluids:
1. Organically inert.
2. Fluid composition shall comply with applicable environmental regulations.
3. Select drilling fluid appropriate for conditions encountered at the Site.

C. Casings:
1. At no additional cost to Owner, install casings as needed for the completion of the work or for protection of existing facilities, utilities, properties, and structures.

D. Detection Wire:
1. Copper wire, solid or braided, with coating to prevent oxidation and deterioration.
2. Minimum Gage: 12 AWG.
3. Secure 2 separate wires to outside of product pipeline.

E. Staging Area Fencing:
1. Orange, plastic safety fence supported by steel fence posts.
2. Minimum Height: 4 feet.
3. Maximum Fence Post Spacing: 8 feet.
4. No vertical sags greater than 6 inches between posts.

F. Water: Water required for the performance of the work may be obtained through the municipal water supply system. Contractor shall coordinate and pay for temporary connections and usage fees.

PART 3 - EXECUTION

3.1 LINE AND GRADE

A. Pilot Hole Alignment:
1. Submit pilot hole alignment data for review prior to reaming and pipe installation.
   a. Alignment data is required to ensure compliance with alignment tolerance performance criteria.
   b. Alignment data submittal review does not relieve the Contractor of responsibility for determining adequate cover for drill fluid containment or other design considerations.
2. Follow the grade of the ground surface. Minimum Cover: 6 feet. Do not create high points in the pipe.Provide Engineer with a tabulation and plot of the pilot hole coordinate data at 25-foot intervals referenced to a datum line located above the entrance and exit elevations of the drill.

B. Final Product Pipeline:
1. Unless otherwise constrained by right-of-way or easement limitations, allowable alignment deviation shall be as follows:
   a. At Locations More Than 50 Feet From Each End:
      1) Horizontal: 5 feet.
      2) Vertical: 5 feet.
   b. At Locations Within 50 Feet From Each End:
      1) Horizontal: 2 feet.
      2) Vertical: 0.5 feet

3.2 STAGING AREAS

A. Drill Staging Area:
1. Disturb as little area as possible while providing adequate area for workers and equipment.
2. Keep area neat and orderly.
3. Install and maintain staging area fencing around perimeter.

B. Pipe Staging Area:
1. Disturb as little area as possible while providing adequate area for workers and equipment and to string, assemble, and inspect pipe.
2. Keep area neat and orderly.
3. Install and maintain staging area fencing around perimeter.
4. Provide protection of exposed ends of pipe to prevent entry by children and animals.

C. Establish and maintain within right-of-way and easement boundaries identified by Owner.

D. Restore to original grade and condition after completion of work.

3.3 INSTALLATION

A. General:
1. Install pilot hole and pipe in conformance with the reviewed submittals.
2. Minimize subsurface disruption during drilling and pullback operations, including the setting of casings if necessary due to Site conditions or Contractor's operations.
3. During pilot hole installation, notify Engineer immediately if partial or full blockage is encountered.
4. Complete operation as expeditiously as possible.
5. Disposal:
   a. Locate an acceptable site for disposal of drilling fluids and excess soils resulting from drilling operation.
   b. Be responsible for transport of materials to and from the Site to the disposal area as well as disposal costs.
   c. Disposal shall comply with applicable environmental and right-of-way regulations.
6. Install and maintain measures to protect existing utilities and physical features from damage during the Project, including but not limited to damage caused by equipment, settlement, or vibration.

B. Vibration and Noise:
   1. Limit vibration to a maximum of 0.2 inches/second on each nearby structure. Provide continual vibration monitoring, maximum of 1 minute data point intervals, on or adjacent to structures affected during activities which may exceed this limit. Provide Engineer with copy of data log.
   2. Limit sound levels to a maximum of 67 dB(A) during non-working hours as measured at nearby occupied structures. Sound levels during working hours shall conform to local regulations, or industry standards if no local regulations exist.

C. Heaving and Settlement:
   1. Actively monitor for signs of heaving and settlement during drilling operations.
   2. Include settling control points on the surfaces or structures as specified below and survey their elevation on a daily basis:
      a. Structures adjacent to the work.
      b. Other points as determined in the field by Engineer.
      c. Other points as required by Contractor.
   3. Readings shall be taken with an optical or laser level with an accuracy of ±0.01-foot.

D. Drilling Fluids:
   1. Source:
      a. Supply materials required for drilling fluids, including but not limited to water.
   2. Inadvertent Returns:
      a. Minimize drilling fluid returns at locations other than drilling entry and exit points.
      b. Immediately clean up inadvertent returns.
      c. Be responsible for paying for costs and obtaining permits required for cleanup efforts.
      d. Be responsible to repair damage caused by inadvertent returns.
      e. Be responsible to repair, clean up, or replace , including temporary water supply required water supply wells affected by inadvertent returns.
   3. Containment:
      a. Ensure that equipment is in working order to prevent leakage.
      b. Provide protective measures on the Site to prevent migration of drilling fluids out of the staging areas.
      c. Immediately remove and clean-up drilling fluids outside of the containment areas.
      d. Protect adjacent waterways and storm water facilities from drill fluid contamination.

E. Drill Head Locating:
   1. Establish method for determining the location of the advancing drill head.
   2. Calculate and plot true vertical depth, horizontal distance and right and left bearing drift.
   3. Verify drill head location at least every 25 feet.

F. Prereaming:
   1. Determine if prereaming is required.
   2. If prereaming is performed:
      a. Determine required diameter to minimize subsurface disruption and allow unhindered pullback of the product pipeline.
      b. Ensure that annular space around product pipeline is stabilized to prevent settlement.
   3. During the operation, monitor the movement of the reaming head to ensure the hole is free of obstructions along the walls which could reduce the cross section of the installed pipe or which may hinder the pullback of the product pipeline.

G. Placement of Pipe:
   1. Pull Back:
      a. Use appropriate connection equipment between product pipeline and pullback pipe to eliminate transfer of rotational forces to product pipeline.
      b. Support pipe as required to ensure a smooth, freely moving pull back.
      c. Control and limit tensile load on the pipe by devices such as hydraulic pressure regulators or load sensors.
      d. The maximum tensile load on the pipe shall not exceed the maximum allowable load recommended by the pipe Manufacturer.

2. Detection Wire:
   a. Secure the detection wire to the outside of the pipe to prevent the wire from being dislodged, broken, or stretched during pullback.
   b. Pull detection wire along with the pipe.

3.4 CLEANING

A. Prior to testing, clean pipe using appropriately sized cleaning swabs. Provide containment, filtering, and disposal required for discharge water. Repeat cleaning swab passes as necessary to remove residual soil and drilling fluid contaminants from the pipeline. Multiple swabs may be run in series at the Contractor's option.

3.5 TESTING

A. Pre-Installation Testing:
   1. Conduct low pressure air test prior to pull-back operation.
   2. Restrain piping and components against uncontrolled movement.
   3. Pressurize to a minimum of 4.0 psi and maintained for a minimum of 2 hours.
   4. Check joints by swabbing with a mild soap solution.
   5. Leaking joints shall be removed and pipeline re-joined in accordance with Manufacturer's recommendations.

B. Post Installation Deflection Testing:
   1. Gage Outside Diameter: Not less than 95% of maximum inside pipe diameter with allowance for weld bead thickness.
   2. Allowable Maximum Deflection: 5% of diameter.
   3. Pull Go-No-Go Gage Through Each Section:
      a. Pulled by one person with no mechanical advantage.
      b. Pulled with mechanical advantage:
         1) Utilize pullback force monitoring and recording device capable of continuous recording and minimum force accuracy of 0.5 pounds.
   4. Go-No Go Gage indicates greater than 5% deflection:
      a. Remove and replace section. Undamaged pipe may be reused.
      b. Vibratory Rerounding Device:
         1) Use not permitted.

C. Post Installation Hydrostatic Pressure Testing:
   1. Restrain piping and components against movement.
   2. Fill pipe and ensure removal of any air.
   3. Subject pipe to minimum test pressure of 150% of the system design pressure for a period of 4 hours to expand the pipe, adding water as necessary to maintain the test pressure.
   4. At the end of the 4 hour expansion phase, decrease the test pressure by 10 psi and discontinue adding water.
   5. The pipeline must hold the reduced test pressure without the addition of water for a period of 1 hour. Any pressure reduction greater than 5% of the reduced test pressure is considered a failing test.
   6. Under no circumstances shall the total time under test exceed 8 hours. If the test is not complete within this time limit, the test section shall be permitted to relax for 8 hours prior to the next test sequence.

END OF SECTION 33 05 30

SECTION 33 10 00 – WATER UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a water distribution system.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. A48 – Grey Iron Castings.
      b. A126 – Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
      c. A167 – Standardized Specification for Stainless and Heat-Resistant Chromium-Nickel Steel Plate, Sheet, and Strip.
      d. A240 – Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
      e. B62 – Composition Bronze or Ounce Metal Castings.
      f. B88 – Seamless Copper Tube.
      g. C478 – Precast Concrete Manhole Sections.
      h. C923 -Standard Specification for Resilient Connectors Between Reinforced Concrete manhole Structures, Pipes, and Laterals.
      i. D429 – Rubber Property-Adhesion to Rigid Substrates.
      j. D449 – Asphalt Used in Dampproofing and Waterproofing.
      k. D1248 – Polyethylene Plastics Molding and Extrusion Materials.
      l. D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
      m. D1785 – Standardized Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80 and 120.
      n. D2657 – Standard Practice for Heat Fusion Joining of Polyolefin Pipe.
      o. D3035 – Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
      p. D3139 – Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
      q. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
      r. F2164 – Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
   2. ANSI/AWWA:
      a. C104/A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
      b. C105/A21.5 – Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
      c. C110/A21.10 – Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids.
      d. C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
      e. C116/A21.16 – Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.
      f. C150/A21.50 – Thickness Design of Ductile-Iron Pipe.
      g. C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
      h. C153/A21.53 – Ductile-Iron Compact Fittings, 3-inch through 24-inch (76 mm through 610 mm), and 54-inch through 64-inch (1,400 mm through 1,600 mm) for Water Service.
      i. C301 – Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, For Water and Other Liquids.
      j. C304 – Design of Prestressed Concrete Cylinder Pipe.

3. AWWA Standards/Manuals:
   a. C502 – Dry-Barrel Fire Hydrants.
   b. C504 – Rubber-Seated Butterfly Valves.
   c. C506 – Backflow Prevention Devices – Reduced Pressure Principle and Double Check Valve Type.
   d. C511 – Reduced Pressure Principle Backflow Prevention Assembly.
   e. C512 – Standard for Air Release, Air/Vacuum and Combination Air Valves for Waterworks.
   f. C515 – Reduced Wall, Resilient Seated Gate Valves for Water Supply Service.
   g. C550 – Standard for Protective Epoxy Interior Coating for Valves and Hydrants.
   h. C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.
   i. C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
   j. C651 – Disinfecting Water Mains.
   k. C655 – Field Dechlorination.
   l. C700 – Cold Water Meters – Displacement Type, Bronze Main Case.
   m. C701 – Cold Water Meters – Turbine Type for Customer Services.
   n. C702 – Cold Water Meters – Compound Type.
   o. C706 – Direct-Reading, Remote-Registration Systems for Cold Water Meters.
   p. C800 – Underground Service Line Valves and Fittings.
   q. C900 – Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water.
   r. C905 – Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36-inch
   s. C906 – Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch for Water Distribution.
   t. M23 – PVC Pipe – Design and Installation.
4. DIPRA – Ductile Iron Pipe Research Association.
5. NFPA – National Fire Protection Association.
6. National Sanitation Foundation (NSF) Standards:
   a. 14 – Plastic Piping System Components and Related Materials.
   b. 60 – Drinking Water Treatment Chemicals.
   c. 61 – Drinking Water System Components.

1.4 DEFINITIONS

A. Abbreviations:
   1. DI – Ductile iron.
   2. PVC – Polyvinyl chloride.

1.5 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Pipe.
      b. Gaskets.
      c. Hydrants.
      d. Valves.
      e. Thrust control materials.
      f. Corporation stops.
      g. Curb box.
      h. Curb stop.
      i. Backflow preventor.
      j. Water meter.
   2. Tapping Materials and Methods: Required Information:
      a. Dimensions.
      b. Details of construction and installation.
      c. Name of Manufacturer.
      d. Model.

3. Procedures: For flushing, pressure testing and chlorinating. Required Information:
   a. Equipment.
   b. Methods.

B. Informational Submittals: Submit Manufacturer's sworn and notarized statements that the materials furnished comply with this Specification.

1.6 QUALITY ASSURANCE

A. Installation Personnel Qualifications:
   1. Trained and experienced in the installation of the materials.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Water Distribution System: Pressure and leak tests.

C. Water Quality: Bacteriological tests.

1.7 PROJECT CONDITIONS

A. Scheduling of Water Shutoffs:
   1. Approval required.
   2. Not to exceed 4 hours.
   3. Standby service may be required by utility agency.
   4. Required Notice:
      a. Fire Department: 48 hours.
      b. Affected Customers: 48 hours.
      c. If local regulations require more notice, the local regulations shall prevail.
   5. Operation of Existing Valves: By Owner's employees only.

B. Contamination of Existing Lines:
   1. Prevent.
   2. Be responsible for all costs of chlorinating and flushing contaminated lines.

PART 2 - PRODUCTS

2.1 PIPE AND FITTING MATERIALS

A. Ductile Iron Pipe:
   1. ANSI/AWWA C150/A21.50 and C151/A21.51.
   2. Pressure Class: PC 350.
   3. Cement Mortar Lining:
      a. ANSI/AWWA C104/A21.4.
      b. Double thickness.
   4. Meet the requirements of ANSI/NSF Standard 61 and the certification must be stamped on the exterior wall of the pipe.
   5. Joints:
      a. ANSI/AWWA C111/A21.11.
      b. Push-on.
      c. Restrained:
         1) 6-Inch Through 24-Inch:
            a) U.S. Pipe: TR Flex Restrained Joint; Field Lok gasket.
            b) American: Flex-Ring Restrained Joint; Fast Grip gasket.
            c) Clow: Super-Lock Restrained Joint.
            d) Griffin Pipe: Snap-lok restrained joint.
            e) Mechanical joint restraint with Megalugs by Ebaa Iron Sales; or equal.
      d. Lubricant: Provide in accordance with Manufacturer’s recommendation.

e. Electrical Continuity:
   1) External Conductor Connection:
      a) U.S. Pipe: Electro-bond.
      b) Erico: Cadweld.
      c) Clow: Cable-bond.
      d) American: Copper strip conductor.
      e) Conduction cable or strap capable of carrying 600 amperes for an extended period without overheating.
      f) Conductor permanently fastened to both sides of joint by shop or field weld.
      g) Epoxy coat field installed jumper strip and connections with Kopper's 300M or equivalent.

B. Fittings:
   1. All fittings shall be restrained to pipe.
   2. Ductile Iron Fittings:
      a. 6-Inch Through 24-Inch:
         1) ANSI/AWWA C153/A21.53, compact fittings.
         2) Mechanical joints.
         3) 350 psi pressure rating.
         4) Lining:
            a) Double thickness, cement mortar lining and coal tar enamel coating inside and outside in accordance with AWWA C104.
      b. Joint Restraint for Ductile Iron Fittings to Ductile Iron Pipe:
         1) 6-Inch Through 24-Inch Pipe:
            a) Mechanical joints with Megalugs by Ebaa Iron Sales; or equal.
            b) Manufactured restrained joints, as indicated on Drawings, to match restrained joint pipe.
      c. Electrical Continuity:
         1) External Conductor Connection:
            a) U.S. Pipe: Electro-bond.
            b) Erico: Cadweld.
            c) Clow: Cable-bond.
            d) American: Copper strip conductor.
            e) Conduction cable or strap capable of carrying 600 amperes for an extended period without overheating.
            f) Conductor permanently fastened to both sides of joint by shop or field weld.
            g) Epoxy coat field installed jumper strip and connections with Kopper's 300M or equivalent.

C. Gaskets:
   1. ANSI/AWWA C111/A21.11.
   2. Styrene Butadiene (SBR).

2.2 MANUFACTURED UNITS

A. Valves:
   1. Manufacturer: EJIW, Clow, US Pipe.
   2. Resilient-Seated Gate Valve: AWWA C515:
      a. Nonrising stem.
      b. Wrench nut, 2-inch square.
      c. Open left (counter clockwise).
      d. Mechanical joint ends.
      e. Stem Seal: Buna-N double O-rings.
      f. Body and Bonnet: Ductile iron.
      g. Wedge: ASTM D429 rubber coated cast or ductile iron.
      h. Coating: AWWA C550 fusion-bonded epoxy.
      i. Pressure Rating: 200 psi.
      j. Stem: Manganese bronze.

3. Air and Vacuum Valve:
   a. Valve shall be designed to release large quantities of air when the pump is turned on and shall close watertight when the pump liquid enters the valve. The valve shall also permit large quantities of air to enter when the pump is turned off.
   b. The body, cover and throttling device shall be cast iron ASTM A48 Class 30. The float shall be stainless steel ASTM A240. The seat shall be HY-CAR rubber or Buna-N.
   c. The discharge orifice shall be fitted with an adjustable throttling device to regulate the flow of air escaping to establish a pressure loading on the rising column of water to minimize shock to the pump and check valve upon closure of the air release valve.
   d. The valve shall be equal to Apco Model 142WD. Crispin Model DID.
4. Backflow Preventors:
   a. Reduced pressure principal backflow preventer.
   b. AWWA C511.
   c. Cla-Val Model RP-4; or equal.
   d. UL, FM approved.
   e. Maximum working pressure: 175 psi.
   f. Flanged ends, 125 pounds ANSI B16.1.
   g. Body: Cast iron ASTM A126.
   h. Epoxy coating interior and exterior.
   i. Stainless steel spring-loaded toggle lever check valve.
   j. In-line differential relief valve to maintain 2 psi (minimum) lower pressure between valves and inlet pressure.
   k. Two test cocks per valve.
   l. Installation must be tested and certified by licensed plumber.
5. Pressure Reducing Valve:
   a. Single-seated, hydraulically operated, pilot controlled, diaphragm type, globe valve.
   b. AWWA.
   c. OCV Model 127-3; or equal.
   d. Automatically reduces higher inlet pressure to constant lower downstream pressure, regardless of changing flow or varying inlet pressure.
   e. Operating Pressure: 75 to 150 psi.
   f. Cast Iron Body: ASTM A126.
6. Valve Boxes:
   a. Manufacturers and Models:
      1) East Jordan Iron Works 8560 with No. 6 base.
      2) Tyler Pipe, 6860 series with #6 base.
      3) Mueller 10357 with No. 160 base.
   b. 5-1/4-inch shaft.
   c. Three section cast iron.
   d. Cast iron lid marked "WATER".
   e. Adjustable:
      1) By means of threaded top and center sections.
      2) Height: 51 inches to 72 inches.
7. Post Indicators:
   a. Manufacturers and Models: Waterous A240; or equal.
   b. Cast iron post.
   c. Window with “OPEN” or “CLOSED” indicator.
   d. Cast iron wrench actuator.
   e. Depth of Bury: 6 feet.

B. Manholes, Vaults and Chambers:
1. General:
   a. Grade Rings: ASTM C478.
   b. Joints:
      1) 1-inch butyl gasket in flexible rope form.
      2) E.Z. Stik, Butyl-Lok; or equal.
   c. Steps:
      1) Manufacturers: MA Industries, PS-1-PF; or equal.
      2) Steel rod, 1/2-inch, encapsulated in copolymer polypropylene.

d. Casting:
   1) Manufacturers and Models: Neenah, R-1670; East Jordan Iron Works, 1045.
   2) Solid, gasketed, self-sealing cover.
   3) Imprinted on Cover: "WATER".
e. Connection Between Manhole and Sewer:
   1) Resilient Connector: ASTM C923 and ASTM A167.
   2) 304 stainless steel bands.
   3) KOR-N-SEAL by NPS, Inc.; or equal.

2. Valve Manholes and Air Release Chambers:
   a. Precast Sections: ASTM C478.
   b. Corporation Stops: Mueller, H-15000; Hays Co., 5200.

C. Hydrants:
1. Manufacturers and Models: East Jordan Iron Works, 5-BR, or approved equal.
2. AWWA C502.
3. Bury Length: 6.5 feet.
4. Outlet Nozzles:
   a. Hose:
      1) Number: 2.
      2) Diameter: 2-1/2 inches.
      3) Threads: NFPA.
      4) Brass.
      5) Fastened by mechanical means.
   b. Pumper:
      1) Number: 1.
      2) Diameter: 4-1/2 inches.
      3) Threads: NFPA.
      4) Brass.
      5) Fastened by mechanical means.
   c. Caps:
      1) Cast iron.
      2) Chained to hydrant barrel.
      3) Operating nut.
5. Main Valve:
   a. 5-1/4 inches in diameter.
   b. Main Valve: Rubber.
   c. Valve Plates: Bronze.
   d. Valve Seat: Brass or bronze.
   e. Valve Facing: Rubber or leather.
6. Inlet connection:
   a. Side.
   b. Diameter: 6 inches.
   c. Mechanical joint.
7. Operating stem and mechanism:
   a. Open left (counter clockwise).
   b. Stem: Steel.
   c. Operating Nut: 1-inch square brass or bronze.
   d. Stem Coupling: Breakable steel with stainless steel cotter pins.
   e. Weathershield: Cast iron.
   f. Protect opening between wrench nut and bonnet with an O-ring.
8. Drain Outlet: Tapped with bronze plug.
9. O-ring Seals: Buna-N.
10. Bolt, Studs and Nuts: Corrosion-resistant.
11. Color: Red.
12. Traffic flange.

2.3 WATER SERVICE MATERIALS

A. General:
   1. General: AWWA C800.
   2. Service Clamps:
      a. Bronze, double strap, iron pipe thread, o-ring seal cemented in place.
      b. Manufacturer: Mueller; Rockwell; or equal.
   3. Corporation Stops:
      a. Bronze, iron pipe thread by compression copper.
      b. Manufacturers: Mueller; McDonald; Ford; Hays; or equal.
   4. Curb Stops:
      a. Bronze, compression copper by compression copper.
      b. Minneapolis pattern.
      c. Manufacturers: Mueller; Ford; McDonald; Hays; or equal.
   5. Curb Boxes:
      a. Minneapolis pattern, extension type.
      b. Manufacturers: Mueller; McDonald; M&E Manufacturing; or equal.

B. Service Lines: Copper: B 88, Type K, soft-temper.

C. Water Service Meter Connections (Indoors):
   1. Copper: ASTM B88, Type K, L, hard drawn.
   2. Copper Horns: Ford No. 3 or 4, Copperhorn; or equal.
   3. Valves:
      a. Inlet Ball Valve:
         1) Ford B11; or equal.
         2) Bronze body, tee head, stem.
         3) O-rings: Buna-N.
         4) Valve Seats: Buna-N.
         5) Ball: Fluorocarbon-coated brass.
   4. Couplings and Fittings: Brass 85-5-5-5 (B 62), flared joints.

D. Displacement Type Water Meters:
   1. AWWA C700.
   2. Guarantee:
      a. AWWA New Meter Accuracy Standards for Minimum of:
         1) Five years, or
         2) 500,000 gallons (5/8-inch Meter), 750,000 gallons (3/4-inch Meter), 1,000,000 gallons (1-inch Meter).
   3. Sensus Technologies, Inc., SR II; or equal.
   4. Measuring Element: Oscillating piston.
   5. Accuracy: 100% ± 1.5%.
   6. Low Flow Registration: 95% at 1/2 gal./min.
   7. Maximum Pressure Loss: 9.0 psi at 30 gal./min.
   8. Size:
      a. 3/4-inch meter for 1-inch service line.
      b. 1-inch meter for 2-inch service line.
   9. Register:
      a. Straight reading.
      b. Hermetically sealed.
      c. Magnetic drive.
      d. 6 odometer wheel display.
      e. 10 gallon increments.
      f. 360 degree test circle with center sweephand.
      g. Low floor detector.
      h. Tamper proof locking system.
   10. Remote Readout:
      a. Sensus Technologies, Self-Generating Remote; or equal.
      b. Straight reading.

c. Hermetically sealed.
d. Magnetic drive.
e. 5 odometer wheel display.
f. 10 gallon increments.
g. Tamper proof locking system.

11. Materials:
    a. Maincase: Bronze.
    b. Bottom Plate: Case iron.
    c. Measuring Chamber: Corrosion resistant thermoplastic.
    d. Magnets: Plasticized material.
    e. Casting Bolts: Stainless steel.
    f. Tamper proof locking system.

E. Compound water meter:
1. AWWA C702.
2. Guarantee: AWWA New Meter Accuracy Standards for a Minimum of:
    a. Five years, or
    b. 1,000,000 gallons.
3. Sensus Technologies, Inc., SRH Compound meter; or equal.
4. Measuring Element:
    a. Low Flow: Piston type positive displacement.
    b. High Flow: Turbine.
5. Bronze swing action diversion valve.
6. Single billing register.
7. Accuracy: 100% ± 1.5%.
8. Low flow registration: 95% at 1/4 gpm.
9. Maximum Pressure Loss: 5.1 psi at 160 gpm.
10. Size: 2-inch meter for 4-inch service line.
11. Register:
    a. Straight reading.
    b. 10,000,000 gallons, 100 gallon/sweep hand revolution.
    c. Hermetically sealed.
12. Remote Readout:
    a. Sensus Technologies, Inc., GTR remote.
    b. Straight reading.
    c. Hermetically sealed.
    d. Gallons.
13. Materials:
    a. Maincase: Bronze.
    b. Bypass Chamber: Bronze.
    c. Piston: Hard rubber.
    d. Turbine: Polypropylene.
    e. Valve: Bronze.
    f. Turbine Chamber: Synthetic polymer.
14. Strainer:
    a. Cast bronze body.
    b. Stainless steel screen.
    c. Flanged end connections.

2.4 MISCELLANEOUS

A. Tracer Wire:
1. 14 gage copper.
2. Brown or black insulation.
3. Splice Wrap: Scotch 2200, vinyl mastic pads.
4. Place on top of pipe.
5. Required with all plastic pipe.

B. Go – No Go Mandrell:
   1. Manufacturer: Cherne Industries, Inc.; or equal.
   2. Gage Outside Diameter: Not less than 95% of base inside pipe diameter.
   3. Minimum 9 fins.
   4. Length:
      a. 4-Inch through 15-Inch Fin Sets: 10-inch.
      b. 18-Inch through 48-Inch Fin Sets: 24-inch.
   5. Required for all plastic pipe installations.

PART 3 - EXECUTION

3.1 EARTHWORK

A. In accordance with Division 31 Section “Excavation and Fill for Utilities.”

3.2 LINE AND GRADE

A. Lay pipe to the grades and elevations indicated on the Drawings.

B. Where No Grades are Indicated:
   1. Lay pipe with a minimum of 6 feet of cover below finish grade.
   2. Lay pipe at constant uphill and downhill grades to and from air release valves.
   3. Avoid high points except at air release valves.

3.3 INSTALLATION

A. General:
   1. Except as herein provided or indicated on the Drawings, install in accordance with:
      a. DI: AWWA C600.
   2. Protect all materials before, during and after installation.
   3. Install pipe, fittings and appurtenances in accordance with Manufacturer's recommendations except as indicated herein or on the Drawings.
   4. Prevent entrance of foreign materials.
   5. Restrain pipe, fittings, valves and couplings as required.

B. Placement of Pipe:
   1. Bearing: Support entire length of pipe barrel evenly with extra excavation at joints.
   2. Bell and Spigot: Clean and lubricate immediately prior to assembly.
   3. Jointing:
      a. Mechanical: Tighten evenly to 75 to 90-foot-pounds of torque.
      b. Restrained: Manufacturer's recommended method.
   4. Cutting Pipe:
      a. Power saw.
      b. Ductile Iron and PVC Pipe: Taper cut end by grinding or filing back at least 1/8-inch on a 30 degree bevel.
   5. Thoroughly clean gasket seating surfaces in the socket and on the plain end of the pipe to remove all coating rust and foreign material before use of conductive gasket.

C. Setting Valves and Valve Boxes:
   1. Set plumb on 4 inches of compacted 3/8-inch (minimum) crushed stone.
   2. Valve Boxes:
      a. Shall not transmit shock to valve.
      b. Plumb over operating nut.
      c. Set cover to finished grade.
      d. Witness.
   3. Pressure Tap Sleeve and Valve:
      a. Set at the direction of tapping Subcontractor.
      b. Set and remove tapping machine.

D. Hydrants: Place “Out of Service” placards or labeled bags on pumper nozzle of all hydrants immediately after installation and on all disconnected existing hydrants. Remove after water main is placed in service.

E. Thrust Control:
   1. Provide at all fittings.
   2. Installation in Accordance With:
      a. Shop Drawings reviewed by Engineer.
      b. Manufacturer's instructions.
   3. Restrain all pipe joints within given distance from each fitting (both directions):

Table 1
Length of Restrained Pipe Required

Pipe Diameter	22-1/2 Degree Bends and Less	45 Degree Bends	90 Degrees Bends, Plugs	Tee Run	Tee Branch
6-inch	5-foot	10-foot	20-foot	10-foot	10-foot
8-inch	5-foot	10-foot	25-foot	10-foot	20-foot
10-inch	5-foot	15-foot	35-foot	10-foot	25-foot
12-inch	10-foot	15-foot	40-foot	10-foot	30-foot
16-inch	10-foot	20-foot	50-foot	10-foot	40-foot

F. Service Leads:
   1. Taps at 45 degrees above center.
   2. Use double strap saddle for all taps on PVC pipe and for services on DIP over 1-1/2-inch.
   3. Direct tap ductile iron pipe for 1/2-inch through 1-1/2-inch services only.
   4. Alignment and Grade:
      a. At right angles with street line.
      b. Minimum depth: 5 feet of cover.

G. Placement of Tracer Wire or Pipe Identification Tape:
   1. Bury 12 inches above water main.
   2. Solder and wrap wire splices.
   3. Splice pipe identification tape to ensure continuity of metal foil.
   4. Bring wire or tape to surface in valve boxes or as directed by Engineer.

3.4 RESIDENTIAL WATER CONNECTION

A. Preparation:
   1. Comply with local plumbing code.
   2. Obtain plumbing permit for each residence and pay all fees.
   3. Organize and coordinate a date and time with each residence to receive a new connection. A list of names, addresses, and telephone numbers will be made available to Contractor.
   4. Review area where water main will enter house and connect to existing plumbing. Organize and coordinate the temporary removal of all false walls.

B. Basement Penetration:
   1. Core drill 3-inch maximum hole for 1-inch or 1-1/2-inch copper service. Hole to be minimum of 5 feet below exterior finished grade.
   2. If basement wall is nonexistent or cannot be drilled, the copper may be fed into the house through the basement floor with mole tunneling equipment.
   3. Seal void between hole and copper with Fosrock, Preco Plug, or equal.
   4. Existing service lines from wells may not be used for new connections, unless approved by Engineer.

C. Connection of New Service Line:
   1. Connect new shut off valve, copper horn, and meter within 3 feet of basement wall.
   2. Continue 1-inch copper to existing house plumbing. Connect to maximum pipe size of system. Provide all copper and fittings necessary to make connection.
   3. Install remote meter reader in a visible location on the exterior of the home, in a location approved by homeowner.

4. Flush water system until water clears, check all new plumbing for leaks.
5. Restore temporary removals or damages to the lawn, driveway, or building.
6. Have homeowner sign a letter of acceptance of the Work, in a form approved by Engineer.

D. Remote Meters:
1. If building does not have a basement, or an area where meter can be installed inside of the first floor, utilize a meter pit.
2. Install meter pit on private property in a location approved by the homeowner.
3. Run new copper into the home and install a new shut off valve. Install new copper to the existing house plumbing.
4. Install remote meter reader on exterior of the home, in a location approved by homeowner.
5. Flush water system until water clears, check all new plumbing for leaks.
6. Restore temporary removals or damages to the lawn, driveway, or building.
7. Have homeowner sign a letter of acceptance of the Work, in a form approved by the Engineer.

E. Disconnection of Existing Well Service Line:
1. Saw cut existing supply line just inside basement wall and plug pipe with threaded or soldered cap.
2. Disconnect bladder tank from house plumbing. Saw cut pipe to tank and cap with threaded or soldered cap.

3.5 TESTING AND DISINFECTION

A. Observation: By Engineer.

B. Notification:
1. Pressure Testing: Arrange with Engineer following successful pretesting.
2. Bacteriological Testing: Arrange with Engineer following successful pressure test.

C. Equipment and Manpower: Provide everything required for testing, disinfection and flushing.

D. Water:
1. To be provided by Owner.
2. Provide temporary connections from Municipal water system to the water main or for hauling water.
3. Provide backflow prevention device.

E. Pressure and Leak Tests for DI and PVC Pipe:
1. ANSI/AWWA C600.
2. Duration: 2 hours.
3. Pressure:
   a. Maintain 150 pounds per square inch at the average elevation in water main segment being tested.
   b. Do not exceed the pipe's rated test pressure.
4. Water:
   a. To be provided by Owner.
   b. Contractor shall be responsible for providing temporary connections and backflow preventor from Municipal water system for hauling water.
5. Make-Up Water: From measurable source.
6. Maximum Allowable Leakage:

$$L = \frac{SxDxP^{0.5}}{148{,}000} + 0.0078 \text{ gal/hr/in of diameter for each closed valve tested against}$$

L = Leakage in gallons per hour.
S = Length of pipe tested in feet; maximum value 2,000. When length of pipe tested exceeds 2,000 feet, the allowable leakage will be based on 2,000 feet.
D = Pipe diameter in inches.
P = Test pressure: 150 pounds per square inch.

7. Maximum Length of Pipe to be Tested: 2,000 feet, or nearest 2 valves if water on opposite side of valve is not in service.
8. Perform test against tapped cap or plug with a standpipe and not against existing valve if water on opposite side of valve is in service.
9. Repair leaks and repeat tests until acceptable results are achieved.
10. Pressure testing against existing valves not allowed.

F. Electrical Continuity:
1. Test ductile iron pipe for continuity using pipe locating equipment by Metrotech or similar method.
2. Repair breaks.
   a. Pulled by 1 person with no mechanical advantage.
3. If Go, No Go Gage Will Not Pass:
   a. Remove and replace section with new materials.
   b. Undamaged pipe may be reused.
4. Vibratory rerounding device not permitted.

G. Disinfection:
1. In Accordance with AWWA C651:
   a. Sodium hypochlorite.
   b. Continuous-feed method.
   c. Calcium hypochlorite granules not required.
   d. Minimum residual 25 parts per million (ppm) initial concentration.
   e. Minimum residual 10 ppm after 24 hours.

H. Flushing:
1. Water main Mainlines: In accordance with AWWA C651.
2. Water Services Into Buildings: In accordance with NFPA 24.
3. Water: [Owner supplied] [Provide].
4. Provide backflow preventor.
5. Velocity:
   a. Water main Mainline: Minimum 3 feet per second in accordance with AWWA.
   b. Water Services (Domestic and Fire Protection): Minimum 10 feet per second in accordance with NFPA.
6. Duration:
   a. Initial: Until entire volume of water in pipeline has been replaced.
   b. Final: Until residual chlorine equals that of adjoining system.
7. Dispose of chlorine residual in accordance with applicable state and local requirements.
8. Disposal location to be inspected by Engineer. Prior to discharge apply a reducing agent to the water to neutralize the chlorine to a 1 ppm residual and in accordance with AWWA C655.

I. Bacteriological Testing:
1. In accordance with AWWA C651 and state regulatory agency requirements.
2. Two consecutive bacteriologically safe samples must be taken at 24-hour intervals for each section of pipe tested.
3. Repeat disinfection if bacteriological test fails.
4. Collect Samples from each branch of pipe, and at a maximum spacing of 1,000 feet.
5. Engineer: Transport Samples to lab for testing.
6. Cost of initial and repeat bacteriological lab tests are the responsibility of Contractor.

J. Sequence:
1. Pressure test.
2. Flush.
3. Chlorinate.
4. Flush.
5. Wait 24 hours.
6. Bacteriological sample.
7. Wait 24 hours.

8. Bacteriological sample.
9. Place in service.

END OF SECTION 33 10 00

SECTION 33 30 00 – SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a sanitary sewer system.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. A48 – Gray Iron Castings.
      b. A167 – Stainless and Heat Resisting Chromium – Nickel Steel Plate, Sheet, and Strip.
      c. A536 – Ductile Iron Castings.
      d. A746 – Ductile Iron Gravity Sewer Pipe.
      e. C14 – Concrete Sewer, Storm Drain, and Culvert Pipe.
      f. C55 – Concrete Building Brick.
      g. C62 – Building Brick (Solid Masonry Units Made from Clay or Shale).
      h. C76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
      i. C139 – Concrete Masonry Units for Construction of Catch Basins and Manholes.
      j. C270 – Mortar for Unit Masonry.
      k. C425 – Compression Joints for Vitrified Clay Pipe and Fittings.
      l. C443 – Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
      m. C478 – Precast Concrete Manhole Sections.
      n. C700 – Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
      o. C923 – Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.D449 – Asphalt Used in Dampproofing and Waterproofing.
      p. D1527 – Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80.
      q. D1784 -Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
      r. D1785 – Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
      s. D2239 – Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
      t. D2241 – Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).
      u. D2282 – Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR).
      v. D2680 – Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Pipe.
      w. D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
      x. D2751 – Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
      y. D3034 – Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
      z. D3035 – Polyethylene (PE) Plastic Pipe (SDR-PR) based on Controlled Outside Diameter.
      aa. D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
      bb. D3262 – Reinforced Plastic Mortar Sewer Pipe.
      cc. D3840 – Reinforced Plastic Mortar Pipe Fittings for Non-Pressure Applications.
      dd. D3965 – Rigid Acrylonitrile-Butadiene-Styrene (ABS) Compounds for Pipe and Fittings.
      ee. D4396 – Rigid Poly(Vinyl Chloride) (PVC) and Related Plastic Compounds for Nonpressure Piping Products.
      ff. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
      gg. F794 – Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
      hh. F2736 – 6 to 30 in. Polypropylene (PP) Corrugated Single Wall Pipe And Double Wall Pipe.
      ii. F2764 – 30 to 60 in. Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.

jj. F949 – Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

2. ASTM Standards:
   a. C12 – Practice for Installing Vitrified Clay Pipe Lines.
   b. C301 – Method for Testing Vitrified Clay Pipe.
   c. C497 – Method of Testing Concrete Pipe, Sections, or Tile.
   d. C822 – Definitions of Terms Relating to Concrete Pipe and Related Products.
   e. C828 – Practice for Low Pressure Air Test of Vitrified Clay Pipe Lines.
   f. C924 – Practice for Testing Concrete Sewer Lines by Low-Pressure Air Test Method.
   g. C969 – Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
   h. C1103 – Practice for Joint Acceptance Testing of Installed Precast Pipe Sewer Lines.
   i. C1244 – Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
   j. C1479 – Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe.
   k. D2321 – Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity – Flow Applications.
   l. D2412 – Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
   m. D3839 – Practice for Underground Installation of Flexible Reinforced Thermosetting Resin Pipe and Reinforced Plastic Mortar Pipe.
   n. F402 – Practice for Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings.
   o. F1417 – Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
3. ANSI/AWWA:
   a. A21.4 – Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
   b. C111/A21.11 – Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
4. NASSCO – National Association of Sewer Service Companies: Recommended Specification for Sewer Collection System Rehabilitation.

1.4 SUBMITTALS

A. Action Submittals: For Product Data:
   1. Pipe materials certification.
   2. Manholes certification.
   3. Mandrel details and certification.
   4. Manhole castings.
   5. Resilient connector.

B. Informational Submittals: Submit Manufacturers' sworn statements that the pipe materials furnished comply with this Specification.

1.5 QUALITY ASSURANCE

A. Installation Personnel Qualifications:
   1. Trained and experienced in the installation of the materials and equipment used on the Project.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Testing as specified in Article 3.4 of this Specification.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Sanitary Service Leads (Laterals):
   1. Material: PVC SDR 23.5 Solid wall. ASTM D3034.
   2. Wyes and Tees:
      a. Sanitary Sewer 8-Inch or 10-Inch Diameter: Wye.
      b. Sanitary Sewer 12-Inch Diameter or Larger: Tee.

c. Cored with resilient rubber connector (boot) on all concrete pipe 18-inch diameter and greater.
3. Plugs or Stoppers:
a. Air-tight seal.
b. Removable without damage to pipe bell.
c. Capable of holding 5 psig.
d. Joints and gaskets to match sanitary sewers.

2.2 MISCELLANEOUS

A. Pipe Deflection Test Gage:
1. Manufacturer: Cherne Industries, Inc.; or equal.
2. Mandrel:
a. 10-inch for 8-inch to 15-inch fin sets.
b. 24-inch for 18-inch to 48-inch fin sets.
3. Fin O.D.: Not less than 95% of base inside pipe diameter.
4. Minimum 9 fins.
5. Allowable Maximum Deflection: 5% of diameter.
6. Provide proving rings to verify accuracy of test gage.

PART 3 - EXECUTION

3.1 PREPARATION

A. Alignment and Grade:
1. If there is a grade discrepancy or an obstruction which is not indicated on the Drawings, notify Engineer and obtain instructions prior to proceeding.
2. Where Sanitary Sewer Crosses Water Main:
a. Expose water main prior to laying sanitary sewer to verify existing depth.
b. Maintain minimum clearance of 18 inches unless otherwise indicated on the Drawings.
3. Control:
a. Laser Beam:
1) Check Line and Grade At:
a) Set-up point, 25 feet, 50 feet, 100 feet and;
b) 200 feet intervals thereafter.
2) Reset projector at each manhole.

3.2 INSTALLATION

A. General:
1. Install pipe, fittings and appurtenances in accordance with Manufacturer's recommendations except as herein specified or indicated on the Drawings:
a. PVC Pipe: ASTM D2321.
2. Prevent entrance of foreign material.

B. Pipe Laying:
1. Bearing:
a. Support entire length of pipe barrel evenly.
b. Provide bell holes at joints.
2. Direction: Commence at outlet and proceed up grade with spigot ends pointing in direction of flow.
3. Method:
a. Clean socket, bell, gasket groove, and spigot.
b. Set gasket.
c. Apply lubricant to spigot.
d. Center spigot end of pipe to be laid and push home against base of socket.
e. Center pipe to form a sewer with uniform invert.
4. Allowable alignment deflection at any point along the pipe.
a. Horizontal: 0.2 inches.
b. Vertical: 0.02 feet of planned grade.

C. Jointing:
   1. All lubricants, gaskets, and solvent cement to be furnished by pipe Manufacturer.
   2. Gaskets:
      a. Surfaces of Joint: Clean and dry before lubricant is applied.
      b. Take care in laying that the pipe does not shift and that gasket remains in a home position after assembly.

D. Service Leads (Sanitary Sewer Laterals):
   1. Locations:
      a. Service lead locations indicated on Drawings are schematic only to represent approximate locations and total number.
      b. Confirm exact service lead location with current property owner (if applicable) or Engineer.
      c. Unless otherwise directed, install service leads at center of vacant lots.
   2. Alignment: Right angles to street centerline, except as indicated otherwise on the Drawings.
   3. Grade: Uniform minimum of 1/8-inch per foot (1%).
   4. Depth:
      a. Elevations at property line indicated on Drawings.
      b. If Drawings are not specific, depth shall be adequate to serve basement of existing building.
      c. At property line of vacant lots, mobile homes or structures not connected to sewer, minimum depth shall be 10 feet or as indicated on the Drawings.
      d. Record depth of end of lateral below finished grade.
   5. Risers:
      a. In event of high groundwater, risers may be required, which decision shall be made by Engineer.
      b. Required if sanitary sewer is more than 12 feet below finished grade.
   6. Plug ends air tight with standard pressure tight plug.
   7. Markers:
      a. Install 2-inch x 2-inch pressure treated wood marking rod at end of each service lead extending vertically from end of lead to within 3 inches of ground surface.
      b. Place 2-inch-long galvanized lag bolt in end of wood rod.
   8. Witnesses and Measurements:
      a. Wyes and Tees:
         1) Measurement to center of nearest downstream manhole.
         2) Note manhole by number indicated on Drawings.
      b. Ends of Service Leads: 3 measurements to permanent surface features.

E. Connections:
   1. To Existing Structures:
      a. Opening: No larger than needed for new pipe.
      b. Brick or Block Structure: Relay and repoint loose blocks and bricks.
   2. For Future Use:
      a. 4-Inch Through 21-Inch Diameter: Plug with standard cap or disc.
      b. 24-Inch and Larger:
         1) Bulkhead with 8-inch thick brick and mortar.
         2) 1/2-inch mortar plaster on outside of bulkhead.

3.3 CLEANING

A. Remove dirt and debris, including cemented or wedged material, from the inside of sewers and manholes before any testing or videotaping.

3.4 TESTING AND INSPECTION

A. Observation: By Engineer.

B. Notification for Testing: Arrange with Engineer following backfill, cleaning and pretesting.

C. Equipment and Manpower: Provide everything required for testing.

D. Alignment and Grade Tests:
   1. Visual:
      a. Each manhole to manhole section.
      b. Mirrors or Lights: Adequate to illuminate the section.

E. Low Pressure Air Test for Leakage:
   1. Required for all types of pipe, except if sewer is live (in service).
      a. Plastic Pipe 4-Inch Through 36-Inch: ASTM F1417.
   2. If the groundwater level is 2 feet or more above the top of the pipe at the upstream end or if the air pressure required for the test is greater than 9 psi gage, the air test should not be used until the groundwater level is lowered by pumping or dewatering.
   3. Test each manhole to manhole section following completion of service leads, risers and other appurtenances.
   4. Pressure: Initially 4.0 psi greater than groundwater back pressure for 2 minute duration.
   5. Pressure Drop:
      a. Measure time interval for pressure drop from 3.5 psi to 2.5 psi greater than groundwater back pressure. Compare with the minimum test time. Measured time interval must be equal to or greater than the minimum test time.
      b. Test Time For Various Pipe Sizes:

Nominal Pipe Size, Inches	Time, Minutes			
	Minimum	250 Feet	300 Feet	400 Feet
10	9:26	9:53	11:52	15:49
12	11:20	14:15	17:05	22:47

   6. Repair leaks and repeat tests until acceptable results are achieved.

F. Deflection Test for Plastic Pipe:
   1. Go, No Go Gage:
      a. Pull go, no go gage through each section:
         1) At least 30 days after completion of backfill.
         2) Pulled by one person with no mechanical advantage.
      b. Go, no go gage will not pass:
         1) Remove and replace section.
         2) Undamaged pipe may be reused.
   2. Vibratory Re-rounding Device:
      a. Use not permitted.

G. Internal Television Inspection of Sanitary Sewers:
   1. General:
      a. Inspect all sanitary sewers using a closed-circuit color television camera.
      b. Provide Engineer with audio-video discs, DVD or Video CD, compatible with playback on any Region I American TV standard DVD player and written logs to document the internal television inspection:
         1) Inspection shall proceed from downstream to upstream, unless otherwise approved by Engineer.
         2) Written logs shall note the location of all sewer laterals and pipe deficiencies by distance from the downstream manhole.
         3) The video shall include audio commentary regarding the sewer condition.
      c. Engineer will review the video and written logs to verify that the sanitary sewers were constructed in accordance with the Contract Documents.
      d. The video shall verify that the sanitary sewers are clean and free of sediment and debris to the satisfaction of Engineer. Sanitary sewers not satisfactorily cleaned shall be promptly cleaned and reinspected by closed-circuit color television camera.
      e. Documentation of television inspection shall be provided and Engineer shall determine that the sewers were constructed in accordance with the Contract Documents before payment for completed sections of sanitary sewer will be recommended to Owner.

2. Performance Requirements:
   a. Inspection procedures and equipment shall meet the applicable standards as presented in the National Association of Sewer Service Companies (NASSCO) Recommended Specifications for Sewer Collection System Rehabilitation.
   b. Each section of sanitary sewer between manholes shall be television inspected separately utilizing a video camera and related equipment specifically designed for the purpose of internal sewer inspection.
   c. The camera speed shall not exceed 30 feet per minute.
   d. The camera shall be stopped for no less than 10 seconds at the entrance manhole, each service lateral, exit manhole, and at all points where the sewer is damaged or deficient.
   e. Lighting for the camera shall be adequate to allow a clear picture of the entire periphery of the sewer and shall be varied as required to be effective for all pipe diameters inspected.
   f. Cables and equipment used to propel the camera shall not obstruct the camera view or interfere with the documentation of the sewer conditions.
   g. The video recording shall be edited as necessary to produce a video sequence proceeding from the most downstream manhole to the most upstream manhole on the mainline run. Branch runs shall be shown in similar downstream to upstream sequencing, subsequent to the mainline sequence.
   h. The mobile recording studio shall have adequate space to accommodate up to 3 persons for the purpose of viewing the video monitor while the inspection is in progress.
   i. Whenever possible, the camera shall move in an upstream direction.
   j. The location of the camera in the sewer shall be monitored by an accurate measuring system which records the distance traveled from the downstream manhole on the video.
   k. All video and written logs shall be clearly labeled with the project name and location identification.
   l. If sewer has dirt and debris which prohibits video inspection, the sewer shall be cleaned and re-televised at no expense to Owner.

END OF SECTION 33 30 00

SECTION 33 32 26 – SUBMERSIBLE GRINDER PUMP STATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the major items listed below:
   1. Submersible wet well/dry well grinder pump station complete with pump(s), valves, piping, control panel, electrical wiring, and related accessories.
   2. Necessary utility connections.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM: C478 – Precast Reinforced Concrete Manhole Sections.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design:
   1. Design station as a duplex packaged wet well/dry well pumping station, including pumps, control panel, electrical quick disconnects, level controls, piping, valves, pump removal system, electrical wiring and related appurtenances.
   2. Pumps:
      a. Submersible sewage grinder pumps with an integral grinder assembly on a common shaft with the pump motor capable of macerating material in normal domestic sewage to a fine slurry.
      b. Explosion-proof with controls that utilize intrinsically safe circuits.
      c. Progressing cavity type with single mechanical seal.
   3. Equipment shall be UL listed and approved for use in hazardous locations.

B. Performance:
   1. Pump Performance Characteristics:
      a. Duplex pump stations: 13 gpm minimum at a total dynamic head of 32 feet operating at rpm for each pump.
   2. Pump Motor:
      a. Duplex Pump Stations: Each pump 1 hp, (maximum) 240V, single phase.
         1) Electrical contractor shall provide buck boost transformer to boost 208V power to pump station to required 240V.

1.5 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings: For submersible grinder pump station.
      a. Dimensions.
      b. Details of each pump station component.
      c. Project specific wiring diagrams for pumps and control panels that identify all field wiring requirements.
   2. Design Data:
      a. Pump performance curves.
      b. Pump horsepower requirements.

B. Informational Submittals:
   1. Manufacturer's Instructions: Submersible grinder pump station installation.
   2. Operations and Maintenance Manuals: For each submersible grinder pump station.
      a. Assembly, installation, alignment, adjustment, and checking instructions.
      b. Equipment function, normal operating characteristics, and limiting conditions.
      c. Maintenance instructions.
      d. Guide to troubleshooting.
      e. Parts list.
      f. Assembly, cross section, and dimensional drawings.
      g. Engineering data and performance curves.
      h. Recommended maintenance and lubrication schedule with lubrication recommendation and predicted life of parts subject to wear.
      i. Wiring diagrams identifying all field connection requirements.
      j. Test data.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Manufacturer's Services:
   1. Submit Manufacturer's certified statement that the installation complies with Manufacturer's requirements.
   2. Provide Manufacturer's field service, start-up assistance, and training of Owner's personnel.

1.7 WARRANTY

A. Manufacturer's Warranty: 2 years from date of start-up on pump, control panel and level controls.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Environment One.
   2. Or equal.

B. The submersible sewage grinder pumps, control panels, wet wells and accessories shall be by a single Supplier.

2.2 COMPONENTS

A. Pump:
   1. Type: progressing cavity type with single mechanical seal and double radial O-ring seals.
   2. Each Pair of Seal Faces: Held in contact by separate spring systems.
   3. Metal parts of seal including spring, external fasteners, and the pump shaft: Stainless steel.
   4. Impeller: Recessed/non-overloading design.
   5. Capable of operating without damage in high head conditions.

B. Grinder
   1. Placed immediately below the pumping element
   2. Directed by a single, one piece motor shaft.
   3. Grinder impeller assembly shall be securely fastened to the pump motor shaft with threaded connection
   4. Grinder impeller to be one piece, 4140 cutter wheel with inductively hardened cutter teeth,
   5. Shredder ring shall be stationary type and made of cast iron.

C. Motor:
   1. Continuous duty.
   2. 1 HP, 1725 RPM, 240 Volt 60 Hetz, 1 phase.
      a. Existing power is 208V, the electrical contractor shall provide buck boost transformer to boost 208V power to pump station required 240V.
   3. Capable of at least 10 starts per hour.
   4. Electrical current shall not exceed 30 Amps.
   5. Capable of operating in a non-submerged condition.
   6. Complete with power and control cables; length as necessary to accommodate pump installation and removal.
      a. Cables to come with NEMA 6P electrical quick disconnect.
   7. Cables shall include conductors in sizes and quantities to meet each application.
   8. Explosion proof.
   9. Motor overheat protection.
   10. Seal failure protection.

D. Integral check valve:
   1. Gravity operated flapper type integral check valve built into stainless steel discharge piping.
   2. Full-port passageway
   3. Material:
      a. Moving parts: 300 series stainless steel and fabric reinforced synthetic elastomer.
      b. Hinge: Nonmetallic
      c. Valve Body: Thermoplastic composite resin.
   4. Rate for 235 psi continuous operating pressure.

E. Integral anti-siphon valve:
   1. Gravity operated flapper type integral check valve built into stainless steel discharge piping.
   2. Full-port passageway
   3. Material:
      a. Moving parts: 300 series stainless steel and fabric reinforced synthetic elastomer.
      b. Hinge: Nonmetallic
      c. Valve Body: Thermoplastic composite resin.
   4. Port shall be no less than 60% of inside diameter of the pump discharge piping.

F. Discharge Assembly and Shutoff Valve
   1. Provide stainless steel discharge assembly with shut off valve.
      a. Shutoff valve to be a stainless steel ball valve rated for 235 psi WOG.
   2. All piping within wet well or dry well shall be 304 stainless steel.
   3. Discharge to terminate at dry well wall with 1 ¼” female NPT fitting.

G. Core Unit
   1. Grinder pump station shall have a cartridge type, easily removable core assembly consisting of pump, motor, grinder, all motor controls, check valve, anti-siphon valve, level controls, electrical quick disconnect, and wiring.
   2. Core Unit shall seal to the tank deck with a stainless steel latch assembly.

H. Lift System:
   1. Grinder pump core to have two lifting hooks complete with lift-out harness connected to its top housing.
   2. Stainless steel lifting chain or cable for each pump to permit removing the pump from the wet well.
   3. Lift system shall allow removal of the pump without disconnecting piping in the wet well.

I. Tank and Integral Accessway (Wet Well / Dry Well):
   1. Polyethylene; 38.8 inches in diameter; Duplex.
   2. Corrugated riser sections: double wall construction.
   3. Drywell accessway shall be integral extension of wet well assembly and shall include a lockable cover assembly.
   4. Corrosion Resistant Cover:
      a. Material: high density polyethylene
      b. Color: Green.
      c. Loading: 150 lbs per square foot.

d. Attached and sealed to integral accessway with stainless steel bolts.

5. Accessway shall enable field adjustment of the station height in increments of 4 inches or less without the use of any adhesives or sealants requiring cure time before installation can be completed.
6. Factory installed piping connections for building sewers and discharge force main.
7. Factory installed electrical conduit connections for power and control wiring.
8. Integral anti-flotation flange or other device.
9. Support brackets for pump removal system and wiring.
10. Factory supplied connector for two (2) 6-inch building sewer connection.
11. Provide 2-inch vent from wet well to accessway cover. Vent shall have a side outlet and discharges to an buried 2-inch PVC vent pipe. Vent to be routed up building to the roof line.

J. Motor and Level Controls
1. All motor starting controls shall be located in the core unit.
2. Level sensing controls:
   a. Shall be housed in a separate enclosure from motor starting controls.
   b. Shall be integral to the pump assembly.
   c. Housing Material: high impact thermoplastic composite.
   d. Operation: pressure switch measuring an integral air column
3. Fastener Materials: 300 Series Stainless Steel.

K. Alarm Panel:
1. NEMA 4X, UL-listed weatherproof enclosure, separately mounted on side of building adjacent to wet well as indicated on the Drawings.
2. Material: thermoplastic composite, corrosion resistance.
3. Provide lockable cover with padlock.
4. Factory Wired Complete With:
   a. 15-amp single pole circuit breaker for alarm circuit
   b. 15-amp double pole circuit breaker per pump core unit for the power circuit.
   c. Complete alarm circuit
   d. Overload relay for each pump.
   e. Control power transformer with primary and secondary overcurrent protection.
   f. Hand-off automatic selector switch for each pump.
   g. Red “run” indicating light for each pump.
   h. LED indicators for:
      1) Satisfactory AC power
      2) Pump run to indicate pump is operating
      3) Trouble indicator and predictive Visual Alarm notification
      4) High level alarm
      5) Manual run switch
      6) Lead/Lag indication
   i. Pump performance menu LED with LCD display with following statistics:
      1) Real-time voltage
      2) Real-time amperage
      3) Real-time wattage
      4) Minimum/Maximum/Average Voltage
      5) Minimum/Maximum/Average Amperage
      6) Minimum/Maximum/Average Wattage
      7) Minimum/Maximum Run-time
      8) Average Run-time
      9) Last Run-time
      10) Cycle/Event Counter
      11) Run Time Counter (Hour Meter)
   j. Diagnostics Menu LED
   k. Initialize System Menu LED
   l. Run Limit Menu LED
   m. Alarm Delay Menu LED
   n. Power Delay Menu LED
   o. Pump alternating options
   p. Pump alternating time options
   q. Non-resettable elapsed time meter for each pump.
   r. Non-resettable event counter.

s. Pump alternator for duplex stations.
t. Alarm light activated by alarm conditions.
u. Audible alarm with push to silence button on bottom of enclosure.
v. Auxiliary relays and terminal blocks as required.

5. Functional Intent:
   a. Control pumps by pressure switches integral to the pump for the following functions:
      1) Pumps off.
      2) Lead pump on.
      3) Lag pump on and high water alarm.
   b. Pumps shall alternate after each cycle.
   c. Pumps shall be an adjustable run time limit.
   d. Low water level, motor over temperature, and motor seal failure shall lock out pump and require manual reset to start.

L. Spare Parts:
   1. Provide the Following::
      a. Grinder Pump Mechanical Seals: 1 per pump.
      b. Grinder Pump Core: 1 including all operational controls, level sensors, check valve, isolation valve, pump/motor unit, and grinder.
      c. Special tools needed to maintain the grinder pump pumping system.
      d. Grinder impellers (cutter wheels).
      e. 2 grinder assemblies.
      f. 2 mechanical seals.

M. Force Main: In accordance with Division 33 Section “Sanitary Utility Sewerage Force Mains.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with:
   1. The Drawings.
   2. Manufacturer's recommendations.
   3. Shop Drawings as reviewed by Engineer.

B. Install piping and wet well in accordance with Division 31 Sections “Excavation and Fill and Utilities” and “Sanitary Utility Sewerage Force Mains.”

C. Electrical Work:
   1. In accordance with the National Electrical Code and all applicable local codes.
   2. The inside of the grinder pump station shall be considered a hazardous location.
   3. Install seal-off fittings in conduits entering/leaving the pump station within 18 inches of the pump station.
   4. Underground cables/wiring shall be installed in 1.5-inch conduit.
   5. Electrical wiring from wet well to control panel shall be without splices.

3.2 FIELD QUALITY CONTROL:

A. Manufacturer's Field Service: Arrange and pay for Manufacturer's field representative to inspect Contractor’s installation of the Manufacturer’s product, provide certified written statement that the installation complies with the Manufacturer’s requirements for a minimum onsite time of 8hours during installation. Schedule as soon as practicable after installation and at times approved by Engineer and Owner.
   1. Manufacturer’s Engineer:
      a. Assist in Start-up: 8 hours observation after pumps are operational.
      b. Demonstrate operation and maintenance to Owner's personnel.
      c. Review operation and maintenance manual with Owner's personnel.

B. Promptly make all changes and additions required by Manufacturer's engineer.

3.3 CLEANING

A. Prior to acceptance of the Work of this Section, thoroughly clean all installed materials, equipment, and related areas in accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 33 32 26

SECTION 33 34 00 – SANITARY UTILITY SEWERAGE FORCE MAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a sanitary sewer force main system.

B. The system design is based on the use of HDPE force main pipe: The use of other pipe materials may require adjustments to other system components.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standard Specifications:
      a. A48 – Gray Iron Castings.
      b. A126 – Gray Iron Casting for Valves, Flanges, and Pipe Fittings.
      c. C76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
      d. C478 – Precast Concrete Manhole Sections.
      e. D429 – Rubber Property – Adhesion to Rigid Substrates.
      f. D449 – Asphalt used in Dampproofing and Waterproofing.
      g. D1248 – Polyethylene Plastics Molding and Extrusion Materials.
      h. D1784 – Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
      i. D1785 – Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120.
      j. D2241 – Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).
      k. D2464 – Threaded Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 80.
      l. D2467 – Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 80.
      m. D2564 – Solvent Cements for Poly(Vinyl Chloride)(PVC) Plastic Piping Systems.
      n. D2657 – Standard Practice for Heat Fusion Joining of Polyolefin Pipe.
      o. D2774 – Underground Installation of Thermoplastic Pressure pipe.
      p. D3035 – Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
      q. D3139 – Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
      r. D3261 – Butt Heat Fusion Polyethlyene (PE), Plastic Fittings for Polyethlyene (PE) Plastic Pipe and Tubing.
      s. D3350 – Polyethylene Plastics Pipe and Fittings Materials.
      t. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
      u. F656 – Primers for Use in Solvent Cement Joints for Poly(Vinyl Chloride)(PVC) Plastic Pipe and Fittings.
      v. F714 – Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
      w. F2164 – Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
   2. AWWA Standards:
      a. C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
      b. C900 – Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water Distribution.
      c. C905 – Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36- inch.
      d. C906 – Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution.
      e. M23 – PVC Pipe – Design and Installation.

3. State DOT Current Standards:
   a. Specifications for Construction.
   b. Standard Plans.

1.4 DEFINITIONS

A. Abbreviations:
   1. DI: Ductile iron.
   2. PVC: Polyvinyl chloride.
   3. HDPE: High density polyethylene.

1.5 SUBMITTALS

A. Action Submittals: For Product Data:
   1. Pipe.
   2. Pipe coating.
   3. Gaskets.
   4. Valves.
   5. Valve boxes.
   6. Manholes, vaults and chambers
   7. Fittings.
   8. Thrust control method.

B. Informational Submittals: Submit Manufacturer's sworn statements that the pipe materials furnished comply with this Specification.

1.6 QUALITY ASSURANCE

A. Installation Personnel Qualifications:
   1. Trained and experienced in the installation of the materials.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Piping System:
   1. Pressure and leak tests.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers.

B. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 PIPE AND FITTING MATERIALS

A. HDPE Pipe:
   1. Material:
      a. Type IV High Density Polyethylene (HDPE) resin material with a density of 0.960 g/cm^3 or greater meeting the specification of ASTM D3350.
      b. Material Designation: PE 4710.
      c. Cell Classification: 445574C; ASTM D3350.
      d. Manufacturing Standard:
         1) Pipe Diameters up to 3 inches: ASTM D3035.
         2) Pipe Diameters 4 inches and larger: ASTM F714.

e. Pipe shall contain no recycled compounds except that generated in the Manufacturer's own plant from resin of the same specification from the same raw material.
2. Manufacturers: Poly Pipe, Inc., Performance Pipe, ISCO Industries; or equal.
3. Size: Ductile iron pipe size, in accordance with AWWA C906 for sizes indicated on Drawings.
4. Dimension Ratio: DR 11.
5. Pressure Rating: 200 psi.
6. Length: 40 feet minimum.
7. Identification: Provide piping with colored striping as follows:
   a. Wastewater: Green.
8. Pipe Joining:
   a. Butt fused joints using equipment and methods in strict accordance with the pipe Manufacturer's recommendations and ASTM D3261 and ASTM D2657.
   b. Joining process shall utilize data logging equipment to document the fusion process.

B. Fittings:

1. HDPE Fittings:
   a. Molded or fabricated from polyethylene compound having a cell classification equal to or exceeding the cell classification of the pipe.
   b. Molded Fittings:
      1) Pressure rated to match the pipe SDR pressure rating to which they are connected.
   c. Fabricated Fittings:
      1) Made from pipe with a pressure rating at least 25% greater than the pipe to which they are connected.
      2) Angle of bends to have tolerance of ±1% of required angle.
   d. Pipe Joining:
      1) Pipe to Fitting Joining: Butt fused using equipment and methods in strict accordance with the pipe Manufacturer's recommendations.
      2) Joining Segments of Fabricated Fittings: Butt fused using equipment and methods in strict accordance with the pipe Manufacturer's recommendations.
   e. Transitions from HDPE Pipe to Other Materials:
      1) AWWA C906:
         a) Mechanical Joint adapter.
      2) Obtain Engineer's approval.
      3) Manufacturers: Phillips Driscopipe, Inc.; Chevron Chemical Company, Plexco; or equal.

C. Gaskets:
1. AWWA/ANSI C111/A21.11 for ductile iron pipe.
2. ASTM F477 for plastic pipe.
3. Styrene Butadiene (SBR).

2.2 MISCELLANEOUS

A. Tracer Wire:
1. 12 gage copper.
2. Brown or black insulation.
3. Splice Wrap: Scotch 2200, vinyl mastic pads.

B. Pipe Installation Tape:
1. Polyethylene material intended for buried use.
2. 6-inch width, 3.5 mils thick.
3. American Public Works Association on color code green with imprinted "Caution Sanitary Force Main."
4. Indentoline by Brady; Pro-Line; or equal.

PART 3 - EXECUTION:

3.1 EARTHWORK

A. In accordance with Division 31 Section "Excavation and Fill for Utilities."

3.2 LINE AND GRADE

A. Lay pipe to the grades and elevations indicated on the Drawings.

B. Where No Grades are Indicated;
   1. Lay pipe with a minimum of 5-1/2 feet of cover below finish grade.
   2. Lay pipe at constant uphill and downhill grades to and from air release and vacuum valves.
   3. Avoid high points except at air release and vacuum valves.

3.3 INSTALLATION

A. General:
   1. Except as Herein Provided or Indicated on the Drawings, Install in Accordance With:
      a. DI: AWWA C600.
      b. HDPE: ASTM D2774.
   2. Protect all materials before, during and after installation.
   3. Install pipe, fittings and appurtenances in accordance with Manufacturer's recommendations except as indicated herein or on the Drawings.
   4. Prevent entrance of foreign materials.
   5. Restrain pipe, fittings, valves and couplings as necessary to comply with this specification.
   6. Thrust Blocks on HDPE Fittings:
      a. Place thrust blocks at all transition fittings to eliminate pipe movement stresses at the fitting.
      b. Pipe and fittings at thrust blocks shall be left accessible for inspection by Engineer.

B. Placement of Pipe:
   1. Bearing: Support entire length of pipe barrel evenly with extra excavation at joints.
   2. Bell and Spigot: Clean and lubricate immediately prior to assembly.
   3. Jointing:
      a. Mechanical: Tighten evenly to 75 to 90 foot-pounds of torque.
      b. Restrained: Manufacturer's recommended method.
      c. HDPE Pipe to HDPE Pipe:
         1) Thermal Butt Fusion: Follow Manufacturer’s recommended method and ASTM D3261.
         2) Mechanical Joint/Flanged Joint Connection:
            a) Thermal butt fuse adapter to HDPE pipe.
            b) Tighten bolts evenly to 75 to 90-foot pounds of torque on slip on ductile flanges.
      d. HDPE Pipe to Other Pipe Materials:
         1) Mechanical Joint:
            a) Thermal butt fuse adapter to HDPE pipe.
            b) Tighten bolts evenly to 75 to 90-foot pounds of torque on slip on ductile flanges.
            c) Provide restraint at mechanical joint as required by conditions.
   4. Cutting Pipe:
      a. Power saw.
      b. Ductile Iron and PVC Pipe: Taper cut end by grinding or filing back at least 1/8-inch on a 30 degree bevel.
      c. HDPE Pipe:
         1) Cut end shall be smooth with no jagged edges or loose material.
         2) Face of cut end shall be perpendicular to pipe wall.

C. Thrust Control:
   1. Provide at all fittings and valves.
   2. Installation in Accordance With:
      a. Shop Drawings reviewed by Engineer.
      b. Manufacturer's instructions.

3. Restrain all pipe joints within given distance from each fitting (both directions):

Table 1
Length of Restrained Pipe Required

Pipe Diameter	22-1/2 Degree Bends and Less	45 Degree Bends	90 Degrees Bends, Plugs	Tee Run	Tee Branch
6-inch	5-foot	10-foot	15-foot	10-foot	5-foot
8-inch	5-foot	10-foot	20-foot	10-foot	5-foot
10-inch	5-foot	15-foot	25-foot	10-foot	10-foot
12-inch	10-foot	15-foot	30-foot	10-foot	15-foot
16-inch	10-foot	20-foot	40-foot	10-foot	25-foot

D. Placement of Tracer Wire and Pipe Identification Tape:
1. Bury 12 inches above force main.
2. Solder and wrap wire splices.
3. Splice pipe identification tape to ensure continuity of metal foil.
4. Bring wire or tape to surface in valve boxes or as directed by Engineer.

3.4 TESTING AND INSPECTION

A. Observation: By Engineer.

B. Notification: Pressure Testing: Arrange with Engineer following successful pretesting.

C. Equipment and Manpower: Provide everything required for testing.

D. Preinstallation Pressure Test for HDPE Pipe Using Low Pressure Air:
1. Test Duration: 2 hours.
2. Test Pressure: 4 psi.
3. Perform prior to pullback of pipe.
4. Restrain the test section and associated piping and components against sudden uncontrolled movement in the event of failure.
5. Pressurize the test section to the test pressure and maintain the pressure for the test duration.
6. Check all joints using a brush and mild soap solution; bubbling shall be considered indicative of a leak.
7. Carefully depressurize the test section.
8. Repair all leaking joints.
9. Repeat test until all joints are leak free.

E. Post-Installation Hydrostatic Test for HDPE Pipe:
1. Fill test section slowly with water.
   a. Purge all air from test section.
   b. Take all appropriate precautions to ensure that no air is trapped in the test section.
   c. Flow velocities during filling should not exceed the capacities of air release devices or other openings used to release entrapped air.
2. Allow the test section and the test liquid to equalize to a common temperature.
3. Initial Expansion Phase:
   a. Test Pressure: 45 pounds per square inch at USGS elevation 665 feet.
   b. When the test section is completely filled and purged of air, gradually increase the pressure in the test section to the test pressure.
   c. Add makeup water as necessary to maintain the test pressure for 4 hours.
4. Test Phase:
   a. Reduce pressure by 10 pounds per square inch.
   b. Monitor pressure for 1 hour.
   c. Do not increase pressure or add makeup water.
   d. Pass/Fail Criteria:
      1) No visible leakage is observed.

2) Pressure During the Test Phase:
   a) Remains steady.
   b) Remains within 5% of test phase pressure for 1 hour.

5. Retesting:
   a. Carefully depressurize the test section.
   b. Correct any faults or leaks in the test section.
   c. Do not attempt to correct faults or leaks while the test section is pressurized.
   d. Allow the test section to relax for 8 hours before re-pressurizing.
   e. After the relaxation period, repeat the initial expansion phase and test phase.
6. Remove and replace pipe if acceptable test results cannot be achieved.

END OF SECTION 33 34 00

SECTION 33 40 00 – STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a storm sewer system.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standards:
      a. A48 – Gray Iron Castings.
      b. A536 – Ductile Iron Castings.
      c. C14 – Concrete Sewer, Storm Drain and Culvert Pipe.
      d. C55 – Concrete Building Brick.
      e. C62 – Building Brick (Solid Masonry Units Made from Clay or Shale).
      f. C76 – Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
      g. C139 – Concrete Masonry Units for Construction of Catch Basins and Manholes.
      h. C270 – Mortar for Unit Masonry.
      i. C443 – Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.
      j. C478 – Precast Concrete Manhole Sections.
      k. C497 – Method of Testing Concrete Pipe, Sections or Tile.
      l. C822 – Definitions of Terms Relating to Concrete Pipe and Related Products.
      m. C923 – Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
      n. C924 – Standard Practice for Testing Concrete Sewer Lines by Low-Pressure Air Test Method.
      o. C1103 – Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Line.
      p. D449 – Asphalt Used in Dampproofing and Waterproofing.
      q. D520 – Zinc Dust Pigment for Paints.
      r. D2412 -Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
      s. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
      t. D3350 – Standard Specifications for Polyethylene Plastic Pipes and Fitting Materials.
      u. F405 – Corrugated Polyethylene (PE) Tubing and Fittings.F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
      v. F449 – Subsurface Installation of Corrugated Thermoplastic Tubing for Agricultural Drainage or Water Table Control.
      w. F1417 – Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
   2. AASHTO Standard Specifications:
      a. M36 – Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
      b. M167 – Standard Plate for Pipe, Pipe Arches, and Arches.
      c. M190 – Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
      d. M252 – Corrugated Polyethylene Drainage Piping.
      e. M294 – Corrugated Polyethylene Pipe, 12 to 60-inch diameter.
      f. M288 – Geotextiles Used for Subsurface Drainage Purposes as modified in MDOT Section 8.09.02.
   3. State DOT Current Standards:
      a. Specifications for Construction.
      b. Standard Plans.

1.4 DEFINITIONS

A. Abbreviations:
1. RCP – Reinforced concrete pipe.
2. HDPE – High density polyethylene pipe.
3. EJ – East Jordan Iron Works.

1.5 SUBMITTALS

A. Action Submittals: For Product Data:
1. Pipe.
2. Manholes.
3. Mandrel.

B. Informational Submittals:
1. Certificates: Manufacturers' certification and sworn statement for concrete materials.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Testing of Material Installation:
1. Light or reflected light test for alignment.
2. Visual inspection for leakage and workmanship.
3. Deflection Testing for HDPE Installation:
a. Electronic deflectometer.
b. Rigid "Go-No Go" device

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. RCP: Premarc Corporation; Northern Concrete Pipe; or equal.

B. HDPE: Phillips Driscopipe; ADS; or equal.

2.2 PIPE MATERIALS

A. RCP:
1. General: Type and class as indicated on the Drawings.
2. Types:
a. Concrete: ASTM C 14.
b. Reinforced Concrete (RCP): ASTM C76.
3. Joints:
a. Premium: Rubber gasket joints on grooved or stepped pipe ends. Lubricants by pipe Supplier.

b. Geotextile Fabric:
   1) Nonwoven.
   2) Width: 3 feet.
   3) Physical Requirements:
      a) Schedule:

	Geotextile Blanket	Geotextile Blanket with MDOT Class II Backfill
Grab Tensile Strength (Minimum), Lbs.	90	
Trapezoid Tear Strength (Minimum), Lbs.	45	
Puncture Strength (Minimum), Lbs.	45	
Mullen Burst Strength (Minimum), PSI	140	100
Permittivity Per Second, Sec^{-1}	0.5	
Apparent Opening Size (Maximum), MM	0.21	0.30 (Pavement and Foundation Underdrains) 0.60 (Other Areas)

      b) For pipe wrap where backfill around the pipe meets MDOT granular material Class II requirements; geotextiles, including knitted polyester sock, which meet the following minimum requirements in the applied condition area permitted:
         (1) Mass/Unit Area: 3.0 oz/sq. yd.
         (2) Mullen Burst Strength: 100 psi.
         (3) Maximum Apparent Opening Size: 0.30 mm for pavement and foundation underdrains; and 0.60 mm in all other areas.
   4) Manufacturers:
      a) Hoechst Celanese Corporation: Trivira 011/250.
      b) Amoco Fabric Company: Propex 4553.
      c) Mirafi, Inc.: Mirafi 180N.
      d) Or equal.

c. Gaskets:
   1) ASTM C443.
   2) Furnished by pipe Supplier.

4. End Sections:
   a. As indicated on the Drawings.
   b. Type:
      1) Flared end section with concrete footing.
         Rodent Guard: As indicated on the Drawings.

B. Corrugated High Density Polyethylene (HDPE) Pipe:
   1. ADS N-12, WTor equal.
   2. Material for pipe production shall be an engineered compound of virgin and recycled high-density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4-inch through 10-inch diameters, and 435420C (ESCR Test Condition B) for 12-inch through 60-inch diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%.
   3. Soil Tight Joints:
      a. 4-inch through10-inch pipe shall meet AASHTO M252, Type S or SP.
      b. 12-inch through 60-inch shall meet AASHTO M294, Type S or SP or ASTM F2306.
      c. Pipe shall be joined using a bell and spigot joint meeting AASHTO M252, AASHTO M294 or ASTM F2306.
      d. Soil Tight Joints shall meet the requirements of ASTM F477.
      e. Soil Tight Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306.
   4. Water Tight Joints:
      a. 4-inch through 60-inch pipe shall meet ASTM F2648.
      b. 4-inch through 60-inch pipe joints shall be watertight according to the requirements of ASTM D3212.
      c. 12-inch through 60-inch joint diameters shall have a reinforced bell with a polymer composite band.
      d. Gaskets shall meet the requirements of ASTM F477.

e. Fittings shall conform to ASTM F 2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of ASTM F 2306.
f. The MEGA GREEN WT IB Pipe shall have an exterior bell wrap installed by the manufacturer.

2.3 MANHOLES, CATCH BASINS AND INLETS

A. Type of Units:
1. As indicated on the Drawings:
2. Precast Reinforced Concrete:
a. Base Section: ASTM C478, separate base slab or base riser section with integral floor.
b. Riser and Cone Sections: ASTM C478.
c. Joints: Premium: ASTM C443, rubber gasket.

B. Hardware:
1. Steps:
a. General:
1) 10 inches deep x 10 inches wide.
2) Tread:
a) Depth: 5 inches.
b) Rail Height: 2 inches.
b. Steel rod, 1/2-inch, encapsulated in co-polymer polypropylene.
2. Castings:
a. Manholes: Neenah R-1642; EJIW, 1040; or equal.
b. Catch Basins: Neenah R-2370 Type G cover; EJIW; 1040 with Type M1 cover; or equal.
c. Curb Catch Basins: Neenah R-3448-C; EJIW 5080; or equal.
d. Yard Basins: Neenah R-2370 Type D or B cover; EJIW 1000 with Type N or M cover; or equal.
3. Mortar: ASTM C270, Type M.
4. Brick:
a. Concrete: ASTM C55, Type I, Grade N.
5. Grade Rings: ASTM C478.
6. Concrete: MDOT S3.
7. Waterproofing:
a. Bituminous: ASTM D449.

2.4 TRENCH DRAIN

A. General:
1. Precast, presloped polymer concrete.
2. Premanufactured in 4-foot minimum lengths.
3. Ductile iron slotted grates.

B. Manufacturer: Dura Trench or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Alignment and Grade:
1. If there is a grade discrepancy or an obstruction which is not indicated on the Drawings, notify Engineer and obtain instructions prior to proceeding.
2. Where Storm Sewer Crosses Water Main:
a. Expose water main prior to laying storm sewer to verify existing depth.
b. Maintain minimum clearance of 18 inches unless otherwise indicated on the Drawings or approved by Engineer.
c. Space joints equidistant from crossing.

3. Control:
    a. Level and Grade Rod: Check line and grade at each structure or cleanout, and 25 foot intervals thereafter.
    b. Laser Beam:
        1) Check Line and Grade At: Set-up point, 25 feet, 50 feet, 100 feet and 100-foot intervals thereafter.
        2) Reset projector at each manhole with a 600 feet maximum.
    c. Allowable Deflection:
        1) Horizontal: 0.20 feet.
        2) Vertical: 0.10 feet.

3.2 INSTALLATION

A. General:
1. Install pipe, fittings and appurtenances in accordance with Manufacturer's recommendations except as herein specified or indicated on the Drawings.
2. Prevent entrance of foreign material.

B. Pipe Laying for Concrete Pipe:
1. Bearing: Support entire length of pipe barrel evenly with extra excavation at joints.
2. Direction: Commence at outlet and proceed up grade with spigot ends pointing in direction of flow.
3. Method:
    a. Wipe clean the socket of pipe last laid.
    b. Center spigot end of pipe to be laid and push home against base of socket.
    c. Center pipe to form a sewer with a uniform invert.
4. Install HDPE pipe in accordance with ASTM D2321 and Manufacturer’s recommendations.

C. Jointing:
1. Mastic:
    a. Surfaces of Joint: Clean and dry before mastic is applied.
    b. Apply mastic to a depth of 1/2-inch or more before placing the pipe.
    c. Take care in laying that the pipe does not shift and that it remains in a home position after assembly.
    d. Remove mastic from inside the pipe for diameters 36 inches and larger.
2. Lubricants: As required for gaskets.
3. Gaskets:
    a. Surfaces of Joint: Clean and dry before lubricant is applied.
    b. Take care in laying that the pipe does not shift and that it remains in a home position after assembly.
4. External Sealing Band:
    a. In accordance with Manufacturer's recommendations.
    b. Ensure stretch of band along bottom of pipe and prevent pulling the sealing band into the joint by keeping the weight of the pipe off the bedding until band is fully installed.
5. Geotextile Wrap: Wrap around joint surfaces.
6. Allowable Joint Tolerance:
    a. Maximum: 1/2-inch at newest surfaces of the joint.
    b. Allowable joint tolerance shall not affect the lines and grades and their permissible to tolerances.

D. Manholes:
1. Base Section Placement: Full and even bearing.
2. Precast Units: Mortar joints, lift holes, and around pipes.
3. Block Units:
    a. Block: Set in full bed of mortar with key slots filled.
    b. Joints: Maximum 1/2-inch wide at inside face and wiped.
4. Top of Casting Elevation:
    a. Gravel Areas: 6 inches below surface.
    b. Bituminous Base Course: At base course grade.
    c. Final Wearing Surface:
        1) At finished grade.

2) Adjustment of castings from base course grade to finished grade is incidental.
3) Ditches: 6 inches below ditch bottom or protruding not more than 6 inches above slope; as applicable.
4) Other Areas: As directed by Engineer or indicated on the Drawings.

5. Waterproofing: Prevent visible leakage.
6. Refer to standard detail on the Drawings.

E. Catch Basins:
1. Base Section Placement: Full and even bearing.
2. Precast Units: Mortar joints, lift holes and around pipes.
3. Block Units:
   a. Block: Set in full bed of mortar with key slots filled.
   b. Joints: Maximum 1/2-inch below gutter grade.
   c. Sump: 1/2-inch mortar coat inside and outside.
4. Casting Elevation:
   a. Gutter Area: 1/2-inch below gutter grade.
   b. Other Areas: As indicated on the Drawings or directed by Engineer.
5. Waterproofing: Prevent visible leakage.
6. Refer to standard detail on the Drawings.

F. Connections:
1. To Existing Structures: Relay and repoint loose blocks and bricks as required.
2. For Future Use:
   a. Bulkhead: With 8-inch thick brick and mortar and 1/2-inch plaster outside.

3.3 REPAIR

A. Treatment of Field Welds and Damaged Galvanized Steel Surfaces:
1. Clean with wire brush.
2. Two coats of zinc rich paint conforming to ASTM D520.

3.4 CLEANING

A. Debris: Remove all dirt and debris, including cemented or wedged material from the inside of all sewers, manholes, and catch basins.

B. Final Acceptance: Clean all sewers, manholes, and catch basins before requesting final acceptance.

3.5 TESTING AND INSPECTION

A. Observation: By Engineer.

B. Notification: Arrange for testing with Engineer following backfill, cleaning, and pretesting.

C. Equipment and Manpower: Provide everything required for testing.

D. Alignment and Grade Tests:
1. Visual:
   a. Each manhole to manhole section.
   b. Mirrors or Lights: Adequate to illuminate the section.

E. Low Pressure Air Test for Leakage:
1. Required for All Types of Pipe.
   a. Concrete Pipe: ASTM C924.
   b. Plastic Pipe: ASTM F1417.
2. Test each manhole to manhole section following completion of service leads, risers and other appurtenances.
3. Pressure: Initially 4.0 psi greater than groundwater back pressure for 2 minute duration.

4. Pressure Drop:
   a. Measure time interval for pressure drop from 3.5 to 2.5 psi greater than groundwater back pressure.
   b. Compare with the minimum test time.
   c. Measured time interval must be equal to or greater than the minimum test time.
   d. Minimum test time for various pipe sizes:

Nominal Pipe Size, Inches	Time, T Minutes/100 Feet
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
36	6.0
42	7.3

   e. If the test section includes more than one pipe size, calculate the test time for each pipe size and add the times together to arrive at the total test time for the section.
5. Repair leaks and repeat tests until acceptable results are achieved.

F. Deflection Test for Plastic Pipe:
   1. Go-No Go Gage:
      a. Standard Details in the Drawings.
      b. Gage O.D.: Not less than 95% of maximum inside pipe diameter.
   2. Allowable Maximum Deflection: 5% of diameter.
   3. Pull Go-No-Go Gage Through Each Section:
      a. At least 30 days after completion of backfill.
      b. Pulled by one person with no mechanical advantage.
   4. Go-No Go Gage Will Not Pass:
      a. Remove and replace section. Undamaged pipe may be reused.
      b. Vibratory Rerounding Device:
         1) Use not permitted.

END OF SECTION 33 40 00

SECTION 33 41 16 – SUBDRAINAGE PIPING (UNDERDRAINS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of an underdrain system.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ASTM Standards:
      a. D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
      b. D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
      c. D7001 – Standard Specification for Geocomposites for Pavement Edge Drains and Other High-Flow Applications.
      d. D4491 -Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
      e. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
   2. AASHTO:
      a. M 252 Corrugated Polyethylene Drainage Tubing.
      b. M 288 Geotextiles Used for Subsurface Drainage Purposes.

1.4 SYSTEM DESCRIPTION

A. Underdrain System:
   1. Perforated pipe wrapped with a geotextile sock, or
   2. Perforated pipe bed in stone with geotextile wrap.

1.5 SUBMITTALS

A. Action Submittals:
   1. Pipe materials.
   2. Geotextile fabric.
   3. Aggregate: ASTM Designation, or sieve analysis.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

PART 2 - PRODUCTS

2.1 UNDERDRAIN PIPE

A. Single Wall High Density Corrugated Polyethylene (HDPE):
   1. Manufacturer: Advanced Drainage Systems, Inc.; or equal.
      a. Pipe:
         1) Perforated Round Single Wall: ADS Single Wall Highway Pipe; or equal.
         2) Perforated Edge Drain: ADS AdvanEDGE; or equal.

3) Size as indicated on the Drawings.
4) Round Pipe: AASHTO M252, Type C or CP.
5) Edge Drain: ASTM D7001.
6) Material Properties: Virgin polyethylene compounds that comply with cell classification 424420C as defined in ASTM D3350.

b. Joints:
1) AASHTO M252 or AASHTO M294.
2) Soil tight split or snap couplings.

c. Fittings: AASHTO M252 or 294.

d. Cleanouts:
1) Solid wall, no perforations.
2) Same diameter as buried pipe.

2.2 GEOTEXTILES

A. Non Woven, Spun Bound.

B. Water Flow Rate: 150 gallons per minute per square foot, in accordance with ASTM D4491.

C. Tensile Strength: 60 pounds in accordance with ASTM D4632.

2.3 AGGREGATES

A. Clean washed open graded stone.

B. AASHTO M 43, No. 8 Aggregate (3/8-inch), or MDOT 34R.

PART 3 - EXECUTION

3.1 PREPARATION

A. Alignment and Grade:
1. If there is an obstruction which is not indicated on the Drawings, deflect underdrain under obstruction.
2. Slope: Maintain minimum 0.5% slope unless Drawings indicate otherwise.
3. Control:
a. Level and Grade Rod: Check line and grade at cleanout and 50-foot intervals thereafter.

3.2 INSTALLATION

A. Install in conformance with ASTM D2321 and the Manufacturer's recommendations.

B. General:
1. Line and Grade: Provide for outlet to storm sewer, ditch, sump pump, or storm water pumping station.
2. Prevent soil and debris from entering system.

C. Geotextile Fabric:
1. Placement.
2. Wrap outside of stone to prevent soil from entering stone, if stone bedding is used.

D. Pipe Laying:
1. Bedding: Inside a bedding of drainage stone or granular material as indicated on the Drawings.
2. Bearing: Support entire length of pipe evenly.
3. Direction: Commence at outlet and proceed up grade.

E. Jointing for Couplings: Furnished by pipe Manufacturer.

F. Cleanouts:
   1. Use solid wall PVC pipe.
   2. Prefabricated wye and elbow or double elbow furnished by pipe Manufacturer.
   3. Location as indicated on the Drawings.
   4. Refer to standard detail on the Drawings.

3.3 CLEANING

A. Remove all dirt and debris from the inside of all pipes.

B. Final Acceptance: Visible inspection by Engineer prior to backfilling.

END OF SECTION 33 41 16

SECTION 334600 - UNDERDRAINAGE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and General and Supplemental Requirements, which are hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of Underdrainage System work is shown on drawings.

B. Underdrainage System Work Includes the Following:

1. Perforated underdrains and connections to existing manholes and catch basins.
2. Rigid drainage system beneath pavement.

C. Related Work Specified Elsewhere: Refer to the entire manual for additional contract requirements,

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for underdrainage system materials and products.

B. Certification: Submit certification signed by underdrainage system installer that installed materials conform to specified requirements and system was successfully checked and tested prior to covering with drainage fill.

C. Record Drawings: At project closeout, submit record drawings of installed underdrainage system piping and products.

1.4 QUALITY ASSURANCE:

A. Installers' Qualifications: Firm with at least 3 years of successful installation experience on projects with underdrainage system work similar to that required for project.

B. Codes and Standards:

1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of underdrainage system's materials and products.

PART 2 - PRODUCTS

2.1 CONDUCTING PIPES AND PIPE FITTINGS:

A. General: Provide pipes of the following materials, of weight/class indicated. Provide pipefittings and accessories of same material and weight/class as pipes, with joining method as indicated. See drawings for size of pipe required.

2.2 PERFORATED DRAINS:

A. Furnish drainage pipe complete with bends, reducers, adapters, couplings, collars and joint materials.

B. Provide perforated, corrugated, single wall polyethylene tubing, ASTM F667.

C. Manufacturer: Subject to compliance with requirements, provide drainage system products of one of the following:

1. Advanced Drainage Systems, Inc., 4640 Trueman Blvd., Hilliard, OH 43026, (800) 821-6710
2. Other approved.

2.3 RIGID DRAINAGE SYSTEM BENEATH PAVEMENT:

A. Provide polyvinyl chloride tubing for drainage and sleeving; see plans for sizing. All material shall be rigid, unplasticized, extruded from virgin parent material. Tubing shall conform with ASTM D-2241 Classification. Pipe shall be Schedule 40, homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, wornholes or dents.

B. Provide insert polyethylene fittings, ASTM D-2609, or PVC fittings with gasketed joints.

2.4 TRENCH MATERIALS:

A. Drainage Fill (Perforated): Evenly graded mixture of clean, washed pea stone.

B. Impervious Fill (Rigid): Clayey gravel and sand mixture capable of compacting to a dense composite.

C. Filter Fabric: Approved non-woven cloth filter fabric from one of the following suppliers, or approved substitute:

1. US Fabrics US 120NW
2. Mirafi 140 N

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Installer must examine the areas and conditions under which underdrainage system work is to be installed and notify the Owner's Representative and Landscape Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 PERFORATED DRAINAGE SYSTEM:

A. Excavation:

1. Excavate for underdrainage system to provide a clear horizontal distance between drain pipe and trench wall on both sides not less than 2 times diameter of drain pipe and sufficient depth to provide not less than 4" compacted impervious fill unless subgrade is already equivalent of impervious fill. Grade bottom of trench excavations to required slope and compact to a firm, solid bed for drain system.
2. Install and compact drainage fill material to not less than 4" depth in bottom of trench.

B. Laying Drain Pipe:

1. Lay perforated pipe solidly bedded in filtering material (pea stone). Provide full bearing for each pipe section throughout its length to true grades and alignment, and continuous slope in the direction of flow.
2. Lay perforated pipe with perforations down and joints tightly closed in accordance with pipe manufacturer's recommendations. Provide collars and couplings as required.
3. Connect pipe runs per plans. Provide positive unobstructed flow.
4. Clean out drainage system, remove all soil and debris that has entered system during construction.

C. Testing Drainage Lines:

1. Test or check lines before backfilling to assure free flow. Remove obstructions, replace damaged components and retest system until satisfactory.
2. After testing drain lines, place not less than 4" additional drainage fill material on top of drain line and either side.

D. Drainage Fill: (Type 1 Drainage Trench)

1. Backfill trench with drainage fill to encapsulate, cover and fill trench to within 4" of finish grade.
2. Cover trench with non-woven cloth filter fabric prior to back filling with soil.
3. Install and compact topsoil over trench as indicated in typical detail.

E. Drainage Fill: (Type 2 Conducting Trench)

1. Backfill trench with drainage fill to encapsulate, cover and fill trench to minimum 4" over top of drainage pipe.
2. Cover backfill with non-woven cloth filter fabric. Ensure complete coverage of drainage fill prior to backfilling trench with soil.
3. Backfill remainder of trench with native excavated material, breakup clumps so as not to exceed 1" in diameter, to within 4" of finish grade.
4. Install and compact topsoil over trench as indicated in typical detail.

3.3 RIGID DRAIN SYSTEM:

A. Excavation:

1. Excavate for underdrainage system to provide a clear horizontal distance between drain pipe and trench wall on both sides not less than 2 times diameter of drain pipe and sufficient depth to provide not less than 4" compacted impervious fill unless subgrade is already equivalent of impervious fill. Grade bottom of trench excavations to required slope and compact to a firm, solid bed for drain system.
2. Install and compact impervious fill material to not less than 4" depth in bottom of trench.

B. Laying Drain Pipe:

1. Lay drainpipe solidly bedded in compacted sand material 95% density (see drawings). Provide full bearing for each pipe section throughout its length, to true grades and alignment, and continuous slope in the direction of flow.
2. Lay rigid pipe with joints tightly closed in accordance with pipe manufacturer's recommendations. Provide collars and couplings as required.
3. Connect rigid PVC to perforated drain tile at walks. Provide positive unobstructed flow.
4. Clean out drainage system, remove all soil and debris that has entered system during construction.

C. Testing Drain Lines:

1. Test or check lines before backfilling to assure free flow. Remove obstructions, replace damaged components, and retest system until satisfactory.
2. After testing drain lines, place not less than 4" additional impervious fill material top of drains and either side.

D. Drainage Fill:

1. Backfill impervious fill (gravel/sand mixture) to encapsulate, cover and fill trench. Compact to within 4” of finish grade depth as indicated in typical detail on drawings.
2. Install and compact topsoil over trench as indicated in typical detail.

3.4 BACKFILLING:

A. General: Conduct backfill operations closely following laying, jointing, and bedding of pipe, and after initial inspection and testing are completed.

3.5 FIELD QUALITY CONTROL:

A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.

END OF SECTION 334600

SECTION 40 05 13 – PROCESS PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of process piping at the splash pad pump station.

B. Work included under this Section:
   1. Non-buried process piping indicated on the Process Drawings.

C. Work not included under this Section:
   1. Buried piping.
   2. Piping indicated on plumbing and mechanical Drawings, including natural gas piping, building drain waste and vent systems, potable water plumbing systems, and piping systems to support HVAC systems.

D. Related Section includes Division 40 Section “Process Valves.”

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. ANSI B 16.5 – Pipe Flanges and Flange Fittings.
   2. ASTM Standards:
      a. A36 – Structural Steel.
      b. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      c. A193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
      d. A194 – Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
      e. A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
      f. A283 – Low and Intermediate Tensile Strength Carbon Steel Plates.
      g. A312 – Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
      h. A403 – Wrought Austenitic Stainless Steel Piping Fittings.
      i. D1784 – Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
      j. D1785 – Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
      k. D2464 – Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
      l. D2467 – Socket Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
      m. D2992 – Obtaining Hydrostatic Design Basis for Reinforced Thermosetting Resin Pipe and Fittings.
      n. D2996 – Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
      o. E8 – Low and Intermediate Tensile Strength Carbon Steel Plates.
      p. E23 – Notched Bar Impact Testing of Metallic Materials.
   3. AWWA Standards:
      a. C 104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fitting for Water.
      b. C 110 – Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water and Other Liquids.
      c. C 115 – Flanged Ductile-Iron Pipe with Threaded Flanges.
      d. C 151 – Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
      e. C 200 – Steel Water Pipe 6 In. and Larger.
      f. C 207 – Steel Pipe Flanges for Waterworks Service – Sizes 4 In. through 144 In.
      g. C 208 – Dimensions for Fabricated Steel Water Pipe Fittings.

h. C 210 – Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
i. C 219 – Bolted Sleeve-Type Couplings for Plain-End Pipe.
j. C 220 – Stainless Steel Pipe, 4-Inch and Larger.
k. C 600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.
l. C 606 – Grooved and Shouldered Joints.
m. C 651 – Disinfecting Water Mains.
n. Design Manual M-11 – Steel Pipe – A Guide for Design and Installation.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Pipe:
1. Design, fabricate and install according to the references and standards specified herein.
2. The Drawings indicate general pipe layout only. Details of joints, couplings, tie rods, supports and make-up pieces are not necessarily indicated. Submit proposed details for these components for Engineer's review.
3. Provide makeup pipe spools, supports and suitable couplings so that piping may be easily separated for removing valves and inline flanged device.

B. Supports and Hangers:
1. The detailed design, layout and spacing of process pipe supports shall be the responsibility of the Contractor. The required locations of some supports may be indicated on the Drawings.
2. Design to prevent pipe sway and movement.
3. Adequate to prevent sagging of plastic pipe.
4. Utilize supporting members as indicated on the structural Drawings for the design, layout and spacing of the process piping supports systems.
5. Design process piping support systems to allow process valves and meters to be removed from the piping system without adding temporary pipe supports to the pipe upstream or downstream of the valve or meter.

1.5 SUBMITTALS

A. Itemized Listings:
1. Equipment to be provided.
2. Deviations from the requirements of this Section.

B. Shop Drawings: For equipment assemblies in this Section to include:
1. Details of construction and installation, including taps, weld-on outlets, water collars, specials, and similar features.
2. Pipe diameter, wall thickness, length, centerline elevations, and locations and dimensions of valves fittings, taps, and in-line equipment and instruments, and similar features.
3. Location and centerline elevation of wall sleeves and wall pipes.
4. Type and location of pipe supports on 8-inch pipe and larger.
5. Details for concrete pipe supports including dimensions, reinforcement, pipe straps and locations proposed for use.
6. Type and location of pipe couplings.
7. Schedule of wall sleeves and pipes indicating proposed sizes, lengths, and connection details.
8. Preliminary testing schedule showing pipe sections to be tested, bulkheads, drains, and chlorine injection locations.
9. Schedule of coatings.

C. Product/Catalogue Data: For all products in this Section to include:
1. Manufacturer.
2. Manufacturer's engineering and specification data.
3. Dimensions, thicknesses, cross-sections, materials of construction.
4. Coatings.

D. Installation Instructions:
   1. Submit complete Manufacturer's installation instructions for all products.
   2. Submit pipe Manufacturer's recommended span lengths between hangers or supports for each pipe size and type.

E. Certifications: Submit Manufacturer's certification that products and materials conform to these Specifications.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, and damage by weather or elements, and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Polyvinyl Chloride (PVC) Pipe Systems:
   1. Use: Splash Pad Pump Station wet well piping.
   2. Materials:
      a. Manufacture pipe, valves, and fittings from material which meets the requirements of Type 1, Grade 1 polyvinyl chloride as outlined in ASTM D1784.
      b. PVC shall have a design stress rating of 2,000 psi at 73 degrees F and 440 psi at 140 degrees F for water service.
      c. Test and approve materials from which pipe, valves and fittings are manufactured for conveying potable water.
      d. Joint Primer:
         1) ASTM F656.
         2) IPS P-70 Purple Primer; or equal.
      e. Solvent Cement:
         1) ASTM D2564.
         2) IPS Weld-on 724 chemical-resistant cement; or equal.
      f. Pipe and Fittings: NSF listed for potable water service and labeled as such.
   3. Pipe: Schedule 80 PVC conforming to ASTM D1785.
   4. Fittings:
      a. Schedule 80.
      b. Socket Type Fittings: Conform to ASTM D2467.
      c. Threaded Type Fittings: Conform to ASTM D2464. Used only where necessary to connect to threaded appurtenances. Use MIL Spec P-27730A Teflon tape when threaded connections are required.
   5. Flange Gaskets: Viton.
   6. Flange Hardware: 316L stainless steel.

2.2 SUPPORTS AND HANGERS

A. General:
1. Design Layout and Spacing of the Pipe Supports: Responsibility of Contractor.
2. Furnish factory fabricated hangers and supports complete with necessary inserts, clamps, bolts, nuts, washers, and accessories.
3. On pipes 12-inch diameter and larger, generally use pipe stand type supports extending to the floor below. Coordinate proposed use of hangers from floors above the pipe with Engineer to ensure that the floors are capable of supporting pipe weight.

B. Manufacturers and Types:
1. Pipe Hangers: Clevis or split ring type with adjustable threaded hanger rods.
2. Hangers and Supports: Grinnell, Unistrut, Crane; or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install process piping and accessories in conformance with:
a. The Manufacturer's recommendations.
b. The Shop Drawings as reviewed by Engineer.
2. Install items to be embedded before concrete is placed.
3. Fasten embedded items securely to prevent movement when concrete is placed.
4. Install items plumb, square, true to lines, grades, elevations, and locations as indicated on the Drawings and herein specified.
5. Do not install chemical piping within finished rooms, regardless of size.
6. Valves, regardless of size and contents, shall be readily accessible. Chemical feed piping valves shall be accessible from operating floor.
7. Do not install chemical feed piping over equipment.

B. Hangers and Supports:
1. Install hangers and supports at less than maximum spacing as recommended by pipe Manufacturer.
2. Adjust hangers and supports to bring pipe lines to proper elevations.
3. Install inserts in concrete flush with the surface and capable of developing the full strength of the bolt.

C. PVC Piping: Installation procedures, including support spacing, solvent welding and allowance for expansion and contraction shall be in accordance with the Manufacturer's recommendations.

3.2 PAINTING

A. Do not paint PVC pipe.

3.3 TESTING

A. General:
1. Hydrostatically test the following process pressure piping lines:
a. Pump Discharge piping.
2. Tests shall be witnessed by Engineer.
3. Provide necessary equipment to perform tests including, but not necessarily limited to pumps, plugs, hoses and gages.

B. Procedure:
1. Pressure test procedure shall be in conformance with AWWA C 600, Section 4.
2. Duration: 2 hours.
3. Pressure: Maintain 150 pounds per square inch.
4. No visible leaks.

C. Repairs: In case of leakage under test, locate and repair leaks in an approved manner and test section again until a satisfactory test is secured.

3.4 CLEANING

A. Thoroughly clean installed materials and Products and related areas:
   1. Prior to acceptance of the work of this Section.
   2. In accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 40 05 13

SECTION 40 05 23 – PROCESS VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of all valves and valve operators in the process piping system at the Splash Pad Pump Station and force main manifold manhole as indicated on the process Drawings and defined in Division 40 Section “Process Piping Systems.”

B. This Section does not include the valves and operators for the piping systems indicated on the plumbing and mechanical Drawings.

C. Related Section includes Division 40 Section “Process Piping Systems.”

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the valves and operators of this Section shall comply with the following as applicable:
   1. ASTM Specification:
      a. A48 – Gray Iron Castings.
      b. A126 – Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      c. A148 – Aluminum Bronze Castings.
      d. A153 – Zinc Coating (Hot Dip) on Iron and Steel Hardware
      e. A240 – Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
      f. A351 – Steel Castings, Austenitic, for High Temperature.
      g. A436 – Austenitic Gray Iron Castings.
      h. A536 – Ductile Iron Castings.
      i. B21 – Naval Brass Rod, Bar, and Shapes.
   2. AWWA Standards:
      a. C 111 – Rubber-Gasket Joints for Ductile-Iron and Gray-Iron.
      b. C 504 – Rubber-Seated Butterfly Valves.
      c. C 507 – Ball Valves 6 In. Through 60 In.
      d. C 508 – Swing Check Valves for Waterworks Service. 2 In. Through 24 In.
      e. C 509 – Resilient-Seated Gate Valves for Water Supply Service.

1.4 SUBMITTALS

A. Shop Drawings:
   1. For equipment assemblies in this Section to include:
      a. Manufacturer.
      b. Model.
      c. Details of construction.
      d. Dimensions, including actuator dimensions and clearances.
      e. Materials of construction.
      f. Listing of components.
      g. Project specific wiring diagrams.
      h. Coatings.
      i. Weight of assemblies.
   2. For each type of equipment installed to include:
      a. Itemized listings.
      b. Deviations from the requirements of this Section.

B. Product Data: For equipment in this Section to include:
   1. Manufacturer.
   2. Model.
   3. Materials of construction.
   4. Manufacturer's engineering and specification data.
   5. Electrical specifications and requirements.
   6. Torque specifications for actuators.

C. Torque calculations for actuators.

D. Installation instructions for equipment in this Section.

E. Operation and Maintenance Manuals: For equipment in this Section to include:
   1. Copy of reviewed Shop drawings and product/catalog data.
   2. Equipment function, normal operating characteristics and limiting conditions.
   3. Assembly, installation, alignment, adjustment and checking instructions.
   4. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   5. Lubrication and maintenance instructions.
   6. Guide to "troubleshooting."
   7. Parts lists and predicted life of parts subject to wear.
   8. Outline, cross-sections, assembly drawings, engineering data, and wiring diagrams.

F. Certifications/Affidavits:
   1. Submit Manufacturer's certification that products and materials conform to these specifications.
   2. Submit an affidavit from the valve manufacturer which certifies that actuators used were furnished and installed by the valve manufacturer.

1.5 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.

B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, and damage by weather or elements and in accordance with Manufacturer's directions.

C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

D. Ship and handle valves in conformance with Section 18 of AWWA C 504.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND TYPES

A. Provide valves of the size and type as indicated on the Drawings and these Specifications.

B. All valves of each type shall be the Product of one Manufacturer.

2.2 MATERIALS AND FABRICATION

A. Gate Valves (GV), 3 Inches in Diameter and Larger:
   1. Conform with the latest edition of AWWA C 509 – Resilient-Seated Gate Valves for Water Supply Service.
   2. Opening Direction: Counterclockwise as viewed from the top.
   3. Stem Seal: V-type packing, O-ring seals or pull-down packing.
   4. Manually operated geared actuators: nonrising stem.
   5. All components within process tanks suitable for submerged service in water.
   6. Test Pressure: 250 psig minimum.
   7. Coating:
      a. Interior surfaces and exterior immersed surfaces: Coat in accordance with AWWA C 550 using an epoxy; Tnemec; or equal.
   8. Manufacturers:
      a. Clow Valve Company.
      b. Kennedy Valve.
      c. M & H Valve Company.
      d. Mueller Company.
      e. Or equal.

B. Swing Check Valves:
   1. Conform with the latest edition of AWWA C 508 – Swing Check Valves for Waterworks Service.
   2. Type: Lever and weight closure or Closure without external devices.
   3. Brass body and disc with aluminum bronze ASTM B148 seat ring.
   4. Disc Seal: Resilient Buna-N for drop tight shut off.
   5. Valve Disc: Double connected to ductile iron disc arm, suspended from a one piece stainless steel shaft, and connected to the lever arm on the outside of the valve.
   6. Coating:
      a. Interior surfaces and exterior immersed surfaces: Coat in accordance with AWWA C 550 using an epoxy; Tnemec; or equal.
   7. Manufacturers:
      a. Mueller.
      b. APCO.
      c. Kennedy.
      d. Val-matic.
      e. Or equal.

C. PVC Ball Valves, Check Valves, Angle Globe Valves:
   1. Furnish PVC true union valves fabricated of the same material as the fittings for piping systems.
   2. Permanently lubricated teflon ball seats.
   3. Viton stem and body seals, vented ball cavity to prevent gas buildup.
   4. True union type with socket or flange connections and a pressure rating of 150 psi C.W.P. at 73 degrees F.
   5. Manufacturer: Hayward, Nibco; GSR; Asahi, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in conformance with:
   1. The Shop Drawings reviewed by Engineer.
   2. The Manufacturer's recommendations.

B. Check and adjust valves, operators and accessories for smooth operation.

3.2 CLEANING

A. Thoroughly clean all installed materials and products and related areas:
   1. Prior to acceptance of the work of this Section.
   2. In accordance with Division 01 Section “Cleaning and Waste Management.”

END OF SECTION 40 05 23

SECTION 46 07 15 – PACKAGED SUBMERSIBLE SANITARY PUMP STATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the furnishing and installation of a packaged pump station, including but not necessarily limited to the items listed below as indicated on the drawings as specified herein and as necessary for the complete performance of the Work:
   1. Submersible Pumps.
   2. Wet Well and access hatch.
   3. Base Elbow and Rail. Control Panel, Panel Devices, and Controller.
   4. Level Floats and other instrumentation items.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   1. American National Standards Institute (ANSI)/American Water Works Association (AWWA):
      a. ANSI B16.1 - Cast iron pipe flanges and flanged fittings.
      b. ANSI/AWWA C115/A21.51 - Cast/ductile iron pipe with threaded flanges.
      c. ANSI 253.1 - Safety Color Code for Marking Physical Hazards.
      d. ANSI B40.1 - Gauges, Pressure and Vacuum.
      e. AWWA C508 - Single Swing Check Valves.
      f. AWWA C504 - Plug Valves.
   2. American Society for Testing and Materials (ASTM):
      a. ASTM A48 - Gray Iron Castings.
      b. ASTM A126 - Valves, Flanges, and Pipe Fittings.
      c. ASTM A307 - Carbon Steel Bolts and Studs.
      d. ASTM A36 - Structural Steel.
   3. Institute of Electrical and Electronics Engineers (IEEE):
      a. ANSI/IEEE Standard 100 - Standard Dictionary of Electrical Terms.
      b. ANSI/IEEE Standard 112 - Test Procedure for Polyphase Induction Motors.
      c. IEEE Standard 242 - Protection of Industrial and Control Power Systems.
   4. National Electric Code (NEC)/National Electrical Manufacturers Assoc. (NEMA):
      a. NEC - National Electric Code.
      b. NEC 701 - National Electric Code article 701.
      c. NEMA Standard MG1 - Motors and Generators.
   5. Miscellaneous References:
      a. Ten-State Standards Recommended Standards for Sewage Works.
      b. Hydraulic Institute Standard for Centrifugal, Rotary and Reciprocating Pumps.
      c. NMTBA and JIC Standard National Machine Tool Builders Association and Joint Industrial Council Standards.
      d. ISO 9001 International Organization for Standardization.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. The Contractor shall furnish and install an automatically controlled submersible pump station with an above ground valve package capable of handling non-potable water from the splash pad .

B. Available Power: 208V, 3 phase

C. Design:
   1. Splash Pad Pump Station Pump P-1 and P-2 shall be submersible pumps complete with motor, lift system, mounting base, and an access cover with frame.
   2. The design shall be such that the pumps shall be automatically connected to the discharge piping when lowered into place on the discharge connection.
   3. The pump shall be easily removable for inspection or service, requiring no bolts, nuts or other fastenings to be removed for this purpose, and no need for personnel to enter pump well.
   4. The pump control panels, pump controllers, and level sensors shall be furnished by the pump Supplier to power and control the pumps as described herein.

D. Performance:
   1. Splash Pad P-1 and P-2:
      a. Primary design duty point: 76 gallons per minute (gpm) at 45 feet total dynamic head (TDH).
      b. Pump shall be capable of a minimum of 50% efficiency at the primary design operating point.
      c. Pumps shall be furnished with a 3-inch minimum discharge connection.
      d. Pump shall comply with NEC Class I Division 1, Group D location requirements.
      e. Pumps shall operate in a Lead-Standby Control sequence with high level override to start all pumps.

1.5 SUBMITTALS

A. Submit in accordance with Division 01 Section “Submittal Procedures.”

B. Shop Drawings:
   1. Submit for pumps, lift system, mounting base, supports, hatch, and control panel.
   2. Required Information:
      a. General:
         1) Dimensions.
         2) Details of construction and installation.
      b. Pump Data:
         1) Manufacturer.
         2) Model.
         3) Performance curves, including:
            a) Rotative speeds, operating points, capacity head curves, efficiencies, brake horsepowers, and shutoff heads, for each variable speed curve. Curve shall also include the impeller diameter.
            b) Submit Manufacturer's catalog curve showing the NPSH required.
         4) Materials of construction.
         5) Pump orientation.
         6) Bearing types and lubrication equipment information.
         7) Seal types.
         8) Weight.
      c. Motor Data:
         1) Manufacturer.
         2) Model.
         3) Rated horsepower.
         4) Efficiency.
         5) Service factor.
         6) Current and load data.
         7) Bearing type.
         8) Weight.
      d. Control Panel, Level Instrumentation and Flow Instrumentation:
         1) Manufacturer’s data for all components.
         2) Project specific wiring diagrams; clearly identifying all field wiring requirements.
         3) Control panel layout and elevation.
         4) Ambient temperature range design considerations, design assumptions, and specifications.
         5) Details of construction and installation.
         6) Mounting details.

e. Station Enclosure:
   1) Weight.
   2) Access.
   3) Dimensions.
   4) Details of construction.
   5) Materials.

C. Operation and Maintenance Manuals: For submersible pump, control panel, and all components.
   1. Equipment function, normal operating characteristics and limiting conditions.
   2. Assembly, installation, alignment, adjustment and checking instructions.
   3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
   4. Lubrication and maintenance instructions.
   5. Guide to "troubleshooting".
   6. Parts lists and predicted life of parts subject to wear.
   7. Outline, cross-sections, assembly drawings, engineering data and wiring diagrams.
   8. Test data and performance curves.

D. File Backup:
   1. General: Backup (on Hard Drive or other electronic media) and hard copies of all program, configuration and firmware files, including drawing and documentation. Contractor agrees to grant to the Owner an exclusive, perpetual, irrevocable, worldwide, and royalty free license to use and modify the Software and related intellectual property provided to fulfill these specifications.
   2. Any configuration that does not reside in a file shall be electronically documented, with “screen shots” included in the submittal or listed in a spreadsheet style document.
   3. Electronic copies of submittal drawings in .dwg format. Include all supporting files.
   4. Provide table of contents file on each hard drive listing contents of directories and subdirectories with description for each file or group of files.

1.6 FUNCTIONAL INTENT

A. Pump Control Panel:
   1. General:
      a. The control system shall include a pump control panel capable of providing power and controls required for pump operation as described herein.
      b. Status information shall be viewable by a user interface.
      c. After stopping a pump, the control system shall not restart that piece of equipment for 30 seconds.
      d. Upon sensing a power failure, the control system shall turn off all active start call outputs. The control system shall not restart equipment until 30 seconds after power is restored. Thirty seconds after sensing a power failure an alarm shall be generated.
      e. The entire system shall restart and resume programmed sequential operations without rebooting or resetting any subsystems upon resuming power after power failure or after the generator automatically starts.
      f. Contractor shall field verify existing conditions and determine exact materials and work required to interface with pump equipment. Contractor shall provide all devices, controls, panels, wiring, and miscellaneous items to achieve the specified functional intent whether specifically itemized or not.
      g. Alarm indications shall remain active until acknowledged by the operator. System inputs for alarm settings, pump control settings, timers, time delays, etc. shall be operator adjustable without software reprogramming.
   2. Splash Pad Pump Station Pumps (P-1 and P-2):
      a. The Pump Supplier shall furnish a Pump Station Control Panel (SPPS-CP). The SPPS-CP shall be equipped with a pump controller for wet well level and float switches. The SPPS-CP shall be programmed, parameterized, and factory tested with the level controls.
      b. Four float switches (LSL-100, LS-100, LS-101, and LSH-100) shall be provided for pump control. Signals from LSH-100 and LSL-100 shall also be sent to the alarm system.
      c. Pumps P-1 P-2 shall be controlled by the pump controller. The pumps shall operate in Lead-Standby configuration controlled by the pump controller. The lead and stand-by pump status shall automatically alternate after each lead pump start. The pump controller shall allow for manual selection of the lead and lag positions.

d. A HAND-OFF-AUTO selector switch shall be provided on SPPS-CP for each pump.
   1) In HAND mode, the respective pump shall start and continue to operate until the selector switch is placed in the OFF position. In HAND mode, pump power shall be manually controlled via pump controller for the respective pump.
   2) In the AUTO mode, the pumps will be controlled by the pump as follows:
      a) In Pump Down Mode, the pumps shall operate in a Lead-Standby Mode. Alternation and selection of the Lead pump can be selected from the OIT. Pump on/off level setpoints shall be operator adjustable from the OIT.
      b) Signals from LSH-100 shall be hardwired to each motor starter. A 5 second (adjustable) time delay between pump starts shall be included in the panel design to prevent simultaneous pump starting.
      c) Signals from LSL-100 shall be hardwired to each motor starter and case each pump to shut down. Signals from LSH-100 and LSL-100 shall also be hardwired to the pump station alarm.

e. Run times for each pump shall be indicated by elapsed run time meters on PSPS-CP. Run time meters shall not be resettable.

f. Pump run status shall be displayed locally on SPPS-CP via a green run indicating light (for each pump) and on the user interface.

g. SPPS-CP shall shut down a pump and generate an alarm in the event that a seal leak or high winding temperature condition occurs at a pump. Seal leak and high winding temperature signals shall shut down a respective pump in HAND and AUTO modes.

h. If a pump fails to start or a pump failure occurs, an alarm shall be generated and that pump shall be taken out of the operating sequence.

i. All setpoints shall be operator adjustable via the user interface.

3. Monitoring:
   a. The following alarms/events shall be continuously monitored and indicated on the OI or control panel:
      1) Pump running (each pump).
      2) High wet well level alarm.
      3) Low wet well level alarm.
      4) Intrusion.
      5) Pump HAND-OFF-AUTO selector switch in AUTO (each pump).
      6) Pump seal failure (each pump).
      7) Pump high winding temperature (each pump).
   b. The following alarms/events shall be indicated via a vandal resistant flashing alarm light located external to the pump control panel enclosure:
      1) High wet well level alarm.
      2) Low wet well level alarm.
      3) Station failure alarm.
   c. The following alarm/events for monitoring only:
      1) Surge Protective Device failure.
      2) Pump current (Amps – each pump).
   d. Provide a minimum of 1 N.O. and 1 N.C. contacts, where applicable, for each alarm/event condition indicated herein and on the Drawings.
   e. Alarms shall remain on until manually reset after correction of alarm condition.
   f. A flow monitoring algorithm is included in the controller to measure influent flow. This algorithm will calculate the incoming flow rate during periods of pump inactivity, detecting the change in level and using the configured wetwell area. Pumping rates are calculated during periods of pump activity, detecting the change in level and using the configured wetwell area and average incoming flow rate. The controller displays incoming flow and totalized flow in gallons per minute. It also displays each pump's rate in gallons per minute.

1.7 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:
   1. Trained and experienced in the fabrication and installation of the materials and equipment.
   2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Manufacturer's Services:
   1. Submit Manufacturer's sworn statement that the equipment furnished complies with this Specification.
   2. Provide Manufacturer's field service.

C. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.8 WARRANTY

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below:
   1. In addition to defects in material and workmanship, station enclosures are warranted for 24 months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.
   2. Pumps and related equipment and parts furnished shall be warranted for 60 months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The packaged pump station shall be Topp Industries, Inc; or Owner approved equal. Submersible pump and accessories shall be Flygt.

2.2 EQUIPMENT

A. Duplex Wet Well Pump:
   1. The Contractor shall furnish and install one custom built and factory tested duplex submersible pump station.

B. Wet Well:
   1. Material: FRP.
   2. Size: 72-inch diameter.
   3. Provide fiberglass encapsulated ASTM A-36 Steel anti-flotation flange.
   4. Access Hatch Frame and Cover:
      a. Clear Opening: To be determined by packaged pump manufacturer.
      b. Provide recessed hasp with a flush hinged lid and fully welded receptacle designed to receive Owner's padlock.
      c. Hardware: 316 Stainless Steel.
      d. Loading capacity: Design for 300 lbf/sq. ft. pedestrian live load with a maximum deflection of 1/150th of the span.
      e. Hinges: Hinges to be located on opposite side of pump guiderails.

C. Submersible Pumps:
   1. Sealed submersible type with nonclogging dynamically balanced impeller.
   2. Pump shall have attached rail guides and discharge elbow.
   3. Provide the pump with a tandem mechanical seal.
   4. All metal parts of seal including spring, all external fasteners, and the shaft shall be stainless steel.
   5. Moisture detection in stator housing.
   6. Pump motor cord shall meet the requirements of the NEC for flexible cords in a wastewater pump station.
   7. Manufacturer and Model:
      a. Flygt NP 3069 SH 3~ Adaptive 275

D. Submersible Pump Motor:
   1. Three phase, 60 Hz, 208 volts, sealed submersible motor.
   2. Capable of continuous duty in a totally, partially, or nonsubmerged condition for extended periods of time.
   3. Non-overloading with horsepower load not exceeding the nameplate rating of the motor at any point of operation on the pump curve.
   4. Meet NEMA standards as listed in NEMA Standard 12.6.
   5. Suitable for installation in a Class I, Division 1, Group D Hazard location.

6. Inverter duty rated with winding and insulation.
7. Thermostat embedded in motor windings to protect from overheating.

E. Protection:
1. Stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125 degrees C (260 degrees F), stop the motor and activate an alarm.
2. A leakage sensor shall detect water in the stator chamber. When activated, the leakage sensor shall stop the motor and activate an alarm.
3. The thermal switches and leakage sensor shall be connected to corresponding monitoring unit designed to be mounted in control panel.

F. Lift System for Pumps:
1. Provide stainless steel pipe rails to guide the pump to the base elbow discharge connection.
2. Furnish a diaphragm-type hydraulically operated sealing flange to seal the pump to the discharge connection.
3. Fit the pump with a stainless steel chain, rated for 1.5 times the weight of the pump, to permit raising for inspection and removal.

G. Mounting Base:
1. Include adjustable guide rail supports and discharge elbow with flange to align with pump hydraulic sealing flange.
2. Discharge Elbow: 125 pound standard flange 3-inch pipe size.
3. Plates and fittings shall be stainless steel.

H. Fasteners Material: ANSI Type 316 stainless steel.

I. Pump Control Panel:
1. General:
a. Control panel shall contain pump controller with user interface, and components described in the Functional Intent, and specified herein plus any additional items (24-volt power supplies, panduit, terminal strips, etc.) necessary for completion of the Work.
b. Control panel shall be arranged to accept a single 208-volt, 3-phase power feeder. Panel shall include an overall (single) disconnect switch that shall be interlocked to prevent unauthorized opening/closing of the Pump Control Panel door with the handle in the ON position. Interlock shall be defeatable.
c. Control panel shall include a 208:120 VAC control power transformer, adequately sized to supply power to connected loads. Control power transformer shall include primary and secondary fusing.
d. Install all wiring in a workmanlike manner: grouped, bundled, labeled, supported and routed horizontally and vertical to provide a neat and organized appearance.
e. Provide transient voltage surge protection on all panel power source(s) and communications wiring.
f. All field 4-20mAdc signals shall be powered from panel, unless indicated otherwise.
g. All field contact closures shall be powered from panel.
h. All wiring shall be sized, labeled and color coded. See electrical Drawings.
i. Provide labeled terminal strips for all wiring entering and leaving the panel at 45 degree stand off.
j. Coordinate and provide all necessary mounting hardware.
k. The OWNER shall be entitled to all upgrades and technical support. Technical reference manuals and user's guides shall be provided for all equipment and software.
l. Cabling, connectors, and accessories shall be provided for all equipment as required.
m. Provide intrinsically safe relays for float switches installed in Class 1, Division 1 areas.
n. Provide intrinsically safe barriers for level sensors installed in Class 1, Division 1 areas.
o. Panel shall be UL labeled and meet the requirements of UL 508. Available fault current is less than 22,000 amps.
p. Provide subplate identification tags made from engraved plastic, white with black letters, for all internal enclosure components.
q. Provide panel face identification tags made from engraved plastic, white with black letters, for subpanel face components.
r. NEMA 3R, 316 stainless steel construction.
s. Front hinged outer access door with locking handle. Hinged inner door for mounting "front of panel" devices.

t. Provide hold open devices on inner and outer doors.
u. Size enclosure to adequately space necessary components in accordance with NEC with 10% extra space.
v. Provide exterior mounted vandal resistant alarm light beacon. Beacon shall turn on for all pump station alarms and failures.
w. Provide cooling fan, louvers and thermostat, integral condensate heater and thermostat.
x. Provide all necessary interior supports to insure panel structural integrity and prevent "oil canning" of side walls.
y. Provide wet well vent piping with hood mounted to side of enclosure.
z. The interior finish, side walls and subpanels shall be painted white.
aa. Provide ground bar (Ilsco D-167, or equal) for each control panel. Ground “lugs” shall not be used. Remove (scrape) paint from subpanel prior to ground bar installation to provide an effective electrical connection.
bb. Manufacturer:
1) Flygt.
2) Or equal.

2. Panel Devices:
a. General:
1) Pilot lights, selector switches and push buttons shall be from same Manufacturer. NEMA ratings shall match that of control panel.
2) Indicators and totalizers shall be from same Manufacturer.
b. Pilot Lights:
1) Heavy duty, oil tight, LED-type, 30.5 mm with push-to-test feature, nameplate and replaceable color lens.
2) Lens Colors:
a) Opened or Motor Running: Green.
b) Closed or Motor Stopped: Red.
c) Alarm or Remote: Amber.
3) Spare Parts:
a) 2 LEDs of each color.
b) 2 of each color lens.
4) Manufacturer:
a) Allen-Bradley, 800T/H.
b) Square D, Type K/SK.
c) Eaton\Cutler-Hammer 10250T, E34.
c. Selector Switches and Push Buttons:
1) Heavy duty, oil tight, 30 mm, with nameplate.
2) Selector Switches: Maintained position, unless specified/indicated otherwise.
3) Push Buttons: Momentary.
4) Manufacturer:
a) Allen-Bradley, 800T/H.
b) Square D, Type K/SK.
c) Eaton\Cutler-Hammer 10250T, E34.
d. Control Relays:
1) Heavy duty, 15 amp minimum, 3-pole double throw (minimum).
2) Pin or blade terminals.
3) DIN mount sockets IP20, finger safe.
4) Indicating light and check button.
5) UL listed.
6) Provide hold down clips for all relays.
7) Provide 2 spare of each type provided.
8) Provide interposing relay for all solenoids and motor loads.
9) Manufacturer:
a) Allen-Bradley.
b) Square D.
c) Magnecraft.
e. Power Failure Relay:
1) Able to monitor 3-phase, 480VAC
2) Wired with front of panel mounted manual reset.
3) Time Mark model 258; or equal.

f. Elapsed Time Meters (ETM):
   1) Input Power: 120 VAC.
   2) Bezel Size: 2-1/2-inch minimum.
   3) Display: 6 digit, non-resettable, 5/32 inch minimum height.
   4) Mechanical “roll-over” digits.
   5) Motor: Synchronous clock.
   6) Manufacturer:
      a) Yokogawa.
      b) Simpson.
      c) Redington.
      d) Cramer.
g. DIN Rail Mounted Miniature Circuit Breakers and Supplementary Protection:
   1) Rated for 250 VAC, 50/60 Hz, 65 Vdc.
   2) Rated cross section for wire sizes #22 to #10 AWG.
   3) Operating life of 6,000 cycles at rated current.
   4) UL listed.
   5) Short-Circuit Current Rating: 10 kA at 125 VAC (minimum).
   6) Provide bus bar where more than 4 circuit breakers are provided in the same panel. Cap unused connectors.
   7) Finger safe terminals.
   8) Amperage ratings of 0.2A to 15.0A, system Supplier shall calculate required ratings, unless otherwise noted.
   9) Manufacturer:
      a) Allen-Bradley.
      b) Square D/Merlin-Gerin.
      c) Moeller Electric.
h. Terminal Blocks:
   1) General: 6mm (nominal), screw type, single tier terminal blocks.
   2) Mounting: Standard TS 35 DIN rail.
   3) Wire Range: 22-2 AWG.
   4) Removable/replaceable marking system (labels).
   5) Manufacturer:
      a) Wieland, WKI series.
      b) Phoenix Contact, UT series.
      c) Weidmuller.
   6) Spare Parts: 25% spare terminal blocks, mounted and unwired.
i. Intrinsic Safety Relays and Barriers together with power supply, system:
   1) General:
      a) Wiring for intrinsically safe systems shall be identified as such through the use of light blue insulation or through appropriate labels.
      b) Suitable for Class 1, Division 1 applications.
      c) Mounting: DIN Rail.
      d) Shall not require a base module.
   2) Intrinsically Safe Relays:
      a) Intrinsically safe relays shall have 1 NO and 1 NC output contact.
      b) Supply Power: 24 VDC or 120 VAC.
      c) Output Contact Voltage Rating: 120 VAC.
   3) Intrinsically Safe Barriers:
      a) General: Galvanic isolation type barrier.
      b) Supply Power: 24 VDC.
      c) Input Source: 4-20 mADC, 2 or 3-wire.
      d) 3-way isolation (input/output/supply).
   4) Accessories: 120 VAC input, 24 VDC output power supply.
   5) Manufacturer:
      a) Pepperl + Fuchs, K-System Series.
      b) Phoenix Contact, PI/Ex-ME Series.
      c) MTL, 5500 Series.
j. LED Alarm Beacon:
   1) General: Weatherproof LED alarm light.
   2) Input Power: 120VAC, 60Hz.
   3) Construction: Hermetically sealed.

4) Operation modes: Steady or flashing.
5) Amber polycarbonate dome.
6) Manufacturers:
   a) Edwards Signaling Products, 52 Series.
   b) Ingram, Sunburst II.
   c) Or equal.
7) Accessories:
   a) Mounting brackets as required.
   b) Protective lens guard.
   c) Spare lamp.

k. Surge Protective Device (SPD):
1) 208VAC 3-Phase:
2) General:
   a) High current device designed to protect equipment and systems from transient over-voltages.
   b) Device shall not interfere with normal operation of circuit being protected.
3) Mounting: Din-rail, IP-20.
4) “Operational/non-operational” visual indication.
5) Protection Method/Type: MOV.
6) Remote indicator contact.
7) Protection Mode: L-L/L-G.
8) Rating:
   a) UL 1449.
   b) 40kA (minimum) surge current capacity.
9) Provide over-current protection as required by Manufacturer.
10) Manufacturer:
   a) Ferraz Shawmut.
   b) Transtector.
   c) Phoenix Contact.
   d) DEHN.

l. High Temperature and Seal Leak Relays:
1) Relays shall supervise temperature and leakage sensors, be designed for use with submersible pumps, and be furnished by Pump Manufacturer. Flygt Mini-Cas; or approved equal.
2) Relay shall plug into a standard 11 pin socket.
3) Relays shall accommodate connection to the following types of sensors:
   a) Temperature switches.
   b) Leakage detector in stator housing.
4) The following alarm conditions shall be monitored:
   a) Overtemperature: If an overtemperature in the stator windings occurs, the unit will turn the pump off and lock it out.
   b) Leakage: If a leakage is detected, after a 5 second delay, an alarm will be activated or the pump will be shut down.
5) Relay Contact Status.
6) Relays must be manually reset on overtemperature. Relays automatically reset on leakage clear.

3. Panel Mounted Pump Controller:
a. Provide the following functionality as standard:
1) Setpoint adjustment for pump activation/deactivation and level alarms.
2) Level input from 4-20mA device.
3) Datalogger.
4) Single-phase supply monitoring and supply protection, including:
   a) Under-voltage.
   b) Over-voltage.
5) Monitoring of dc supply, battery voltage, and internal temperature

b. Provide the following optional functionality:
   1) Motor protection and power module including:
      a) Over and under current.
      b) Ground/earth fault.
      c) Insulation resistance testing for motor windings.
      d) KVA, kW and power factor measurement.
      e) Provide CTs as required.
c. User Interface:
   1) Status display to include the following:
      a) Level.
      b) Setpoints for alarms and pump start/stop.
      c) Pump running/stopped.
      d) Single-phase current for each motor.
      e) Pump fault.
   2) Information Screens to include:
      a) Hours Run accumulators for each pump and the station.
      b) Starts accumulators for each pump & the station.
      c) Flow values, from flow meter.
      d) Fault Screen.
      e) History Screen.
      f) Configuration Screen.
d. Pump/Motor Leak and Thermal Switch input protection for each pump/motor.
e. Battery back-up with charger and failure monitor.
f. Provide accessories as required to monitor:
   1) Surge Suppression failure.
   2) Control Panel On.
   3) Low Low Level.
   4) High High Level.
g. Manufacturer and Model:
   1) Multitrode MultiSmart.
   2) Or Equal.

4. Float Type Level Switch (Mercury Free):
   a. Direct acting.
   b. Molded corrosion resistant, polypropylene or PVC body suitable for fluid application.
   c. Float switches shall have 1-inch actuation/de-actuation level.
   d. Cable shall be PVC type STO with No. 18 AWG (minimum) conductors:
      1) Jacket for cable shall be factory molded to the float.
      2) Minimum cable length of 40 feet.
   e. Hazardous Location: Level switch and switch circuit shall be intrinsically safe and suitable for sensor mounting in a Class 1, Division 1, Group D hazardous area.
   f. Manufacturer: Anchor Scientific “Eco-Float”; or equal.
   g. Accessories: Corrosion resistant hardware and mounting accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in conformance with:
   1. The Shop Drawings reviewed by Engineer.
   2. The Manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Arrange and pay for Manufacturer's engineer to provide the services indicated below for a minimum onsite time of two 8-hour days per Pump Station. Schedule the following as soon as practicable after installation and at times approved by Engineer and Owner.
   1. Manufacturer's Engineer: Check work, assist in start-up, demonstrate operation and maintenance to Owner’s personnel, review operation and maintenance manual with Owner’s personnel.

B. Promptly make all changes and additions required by Manufacturer's engineer.

C. Field Performance Demonstration:
   1. General:
      a. Checklist shall be developed by system Supplier and submitted to Engineer for review prior to scheduling demonstration. Checklist shall have location for system Supplier to indicate completion of each item. System Supplier shall submit completed checklist to Engineer prior to performing demonstration.
      b. Schedule a minimum of 2 weeks in advance.
      c. Schedule and coordinate with Owner and Owner's operation staff.
      d. Demonstration shall be repeated as required until satisfactory results are obtained.
   2. Equipment:
      a. Demonstrate proper operation to Owner and Engineer.
      b. Demonstrate that system performs control functions as specified.
   3. Instruments:
      a. Demonstrate proper calibration and maximum accuracy.
      b. Demonstrate that system performs monitoring functions as specified.

3.3 SYSTEM TRAINING

A. System Supplier's engineer shall provide training for system operators.
   1. Provide 2-hour (minimum) training session to demonstrate and explain operation of all process control and instrumentation equipment and systems at each Pump Station. Demonstrations and explanations shall utilize installed equipment and be "hands-on." Training time shall be mutually agreed upon with Owner. Training sessions shall be held at each project site.
   2. Provide handouts and notes to facilitate training as necessary. Operations and maintenance manuals shall be reviewed as applicable during training session.

END OF SECTION 46 07 15