

PROJECT MANUAL

Pulaski County Parks and Recreation

Facility Renovation Pulaski County Indoor Sportsplex and Expo Center

Architect's Project No. 2024060

April 10, 2025

Bidding/Construction Documents



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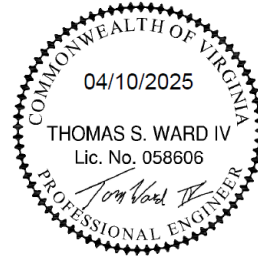
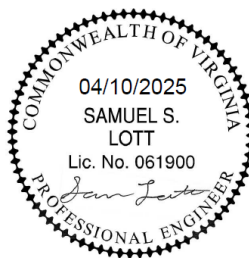
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Not Used

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PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX AND EXPO CENTER

PROFESSIONAL SEALS



ADVERTISEMENT FOR BIDS

Pulaski County Parks and Recreation, hereinafter referred to as the **Owner**, invites qualified contractors to submit sealed bids for **Facility Renovation Pulaski County Indoor Sportsplex and Expo Center** according to Bidding Documents prepared by ZMM, Inc. Architects and Engineers. Sealed bids will be received at the Pulaski County Administration Building, **143 Third Street NW, Suite 1, Pulaski, Virginia 24301** until **2:00p.m.**, local time, on **May 15, 2024** at which time and place the bids will be publicly opened and read.

A pre-bid conference will be held at **10:00 a.m.** local time, on **April 24, 2025** at the offices of the Owner, **located at 3994 Pepperell Way, Dublin, Virginia 24084**. A tour of the facility will follow afterward. Attendance at pre-bid conference is mandatory for prime contract bidders only.

Bidding Documents can be obtained by one of the following methods:

1. Prime Contract Bidders only may contact ZMM, Inc. Architects and Engineers **Attn: Greg Goetz; ggoetz@zmm.com** and request information to access the firm's online ShareFile site for the **Facility Renovation Pulaski County Indoor Sportsplex and Expo Center** project. Once access is gained, Bidders can download Bidding Documents in the form of PDF files at no charge. Requests for access to documents must be made by email, and those requests received through mail, telephone, fax transmission, or other online communications will not receive a response.
2. Hard Copies may be obtained from Charleston Blueprint (304-343-1063) by General Contractors, Subcontractors, material suppliers and dealers by paying the actual cost of printing, binding and mailing; however such cost is not refundable.

Bidding documents may be examined at Viewing Depositories listed in the Bidding Documents.

Each bid shall be accompanied by a bid bond, made payable to the Owner, in the amount of five percent (5%) of the base bid, in accordance with the Instructions to Bidders.

Bidders are required under Title 54.1, Chapter 11, Code of Virginia (1950), as amended, to be licensed as a "Class A Contractor" before submitting a bid of one hundred twenty thousand (\$120,000) dollars or more; or to be licensed as a "Class B Contractor" before submitting a bid of ten thousand (\$10,000) dollars or more but less than one hundred twenty thousand (\$120,000) dollars; or be licensed as a "Class C Contractor" before submitting a bid of no more than ten thousand dollars (\$10,000).

Each Bidder will be required to give their State Registration Number on their proposal. All non-resident contractors and subcontractors bidding the work described herein shall register with the Department of Labor and Industry under the provisions of Section 40.1-30 of the Code of Virginia.

The Owner reserves the right to reject any or all bids, the right to waive minor informalities and procedures in bidding, and the right to withhold final award of contract for 60 days after opening bids.

The bidder to whom the contract is awarded shall execute and deliver to the Owner within 10 days after the award, and before signing the contract, a Performance Bond and Payment Bond utilizing the bond forms bound in the Project Manual each in a penal sum equal to at least the contract sum and the cost of such bonds shall be included in the bid.

The Pulaski County is an equal opportunity/affirmative action employer. The County does not discriminate on the basis of race, color, national origin, sex, age, disability, or religion. The County does not discriminate against faith-based organizations in accordance with the Code of Virginia § 2.2-4343.1.

The successful bidder will be required to obtain a Pulaski County Business license prior to beginning work.

ZMM
ARCHITECTS ENGINEERS
1116 South Main Street
Blacksburg, Virginia 24060
(540) 552-2151

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

To be considered, bids must be made in accordance with these Instructions to Bidders.

A. Documents

1. Plans and specifications can be obtained via download from ShareFile **at no cost**. Contact ggoetz@zmm.com for ShareFile access. Upon receipt of valid email address, ZMM will provide a password with instructions on accessing and downloading plans and specifications. Hard copies of plans and specifications can be obtained from ZMM upon receipt of a nonrefundable check in the amount of \$150.00. Plans and specifications can be shipped for additional charge.

2. No partial sets will be issued.

B. Obligation of Bidder

1. By submitting a bid, the bidder covenants and agrees that they are satisfied from their own investigation of the conditions to be met, that they fully understand their obligation and that they will not make any claim for, or have right to cancellation or relief from the contract because of any misunderstanding or lack of information.

C. Questions

1. Submit all questions and comments about the drawings and specifications to the Architect/Engineer in writing to 1116 South Main Street, Blacksburg, VA 24060 or via e-mail to ggoetz@zmm.com. Replies will be issued as addenda to the drawings and specifications and will become part of the contract. Addenda will be posted on the ZMM **ShareFile** website. Planholders who have obtained authorization to download drawings and specifications from the ZMM **ShareFile** website will also have access to the "Addenda" folder where all addenda will be posted. Immediately report any technical problems with the ZMM **ShareFile** website by calling the office of ZMM at (540) 552-2151. The ZMM **ShareFile** website will send notifications to the authorized Contractors when addenda are posted on the website. Planholders shall submit a valid email address to the office of ZMM when requesting plans and specifications. This email address shall have open security settings to allow receipt of addenda notifications generated from the ZMM **ShareFile** website (example: mail@sf-notifications.com). It is the Planholders responsibility to visit the ZMM **ShareFile** website and download the addenda. ZMM shall not be held responsible for email notifications not received by Planholders. Addenda posted on the ZMM **ShareFile** website may be accessed by any party, at any time. New addenda may be posted, and new addendum notification emails sent to Planholders up to 24 hours prior to bid opening.

D. Substitutions

1. Approvals and/or Submittals Prior to Bidding: The Bid Documents shall not require samples, shop drawings, or similar materials to be submitted for approval prior to receipt of bids. Bids shall be based upon the materials and equipment as indicated in the Contract Documents. No substitutions will be approved prior to bidding.

2. Approvals of Submittals: The specifications contain sufficient information to describe to the Contractor and bidders the performance and quality standards that will be used to evaluate the submittals.

3. Brand Names: Brand names may be utilized in the contract documents.

4. Equal Materials, Equipment or Assemblies: **Unless otherwise stated in the specifications**, other brand, make or manufacturer of a product, assembly or equipment which in the opinion of the Architect/Engineer is the equal of that specified, considering quality, capabilities, workmanship, configuration, economy of operation, useful life, compatibility with design of the work, and suitability for the intended purpose, may be accepted. The Contractor may submit to the Architect/Engineer a request for substitution during the shop drawing submittal phase. All such requests shall be submitted in writing and shall be accompanied by a Substitute Request Cover Sheet, itemized list of deviations from specified product, complete manufacturer's literature, specifications, and cutsheets covering the proposed substitute materials and the manufacturer's recommendations for installation. It shall be understood that the burden of proof for a substitute or an "or equal" material shall be on the Contractor.

E. Basis of Bid

1. The bidder must include the base bid, all alternate bid items, all unit prices, and all other items shown on the bid forms; failure to comply may be cause for rejection.

F. Preparation of Bids

1. Bids shall be made on unaltered bid forms as furnished in Section 00300 - FORM OF PROPOSAL. Fill in all blank spaces. Bids shall be signed with name typed below signature. Where bidder is a corporation, bids must be signed with the legal name of the corporation, followed by the name of the state of incorporation and the legal signature of an officer authorized to bind the corporation to a contract.

2. No bids shall be withdrawn for a period of sixty (60) days after the scheduled bid opening time.

G. Bid Security

1. Bid security shall be made payable to Giles County School Board in the amount of 5% of the total bid sum. Security shall be either certified check or bid bond issued by a surety licensed to conduct business in the State of Virginia. The successful bidder's security will be retained until he has signed the contract and furnished the required performance and payment bonds. The owner reserves the right to retain the security of the next two lowest bidders until the lowest bidder enters into contract or until sixty (60) days after the bid opening, whichever is shorter. All other bid securities will be returned as soon as practicable. If any bidder refuses to enter in a contract, the Owner will retain his bid security as liquidated damages, but not as a penalty. The amount of bid security retained shall be the difference between the bid for which the bond was written and the next low bid in accordance with Title 2.2, Chapter 43, Part 36 of the Virginia Code.

H. Performance, Payment and Material and Labor Bonds

1. The successful bidder, if awarded the contract, shall provide a proper performance and payment bond, covering up to the full amount of the contract price as security for the faithful performance of all work under the contract and payment of all charges in connection therewith. Cost of said bond to be included in base bid. The failure of the bidder to whom the award is made to execute the agreement and supply the required bonds within ten (10) business days after award of contract or within such extended period as the Owner may grant, shall constitute a default and the Owner may award the next lowest bidder in succession and charge against the defaulting bidder the difference up to the total amount of the bidder's bid security.

I. Subcontractors

1. Names of the principal subcontractors must be listed as called for in the Form of Proposal. No change in this list may be made after the bid unless approved by the Architect/Engineer. Subcontractors and material suppliers, other than those listed in the Form of Proposal, shall be submitted to the Architect/Engineer for approval within 10 days after execution of the contract.

J. Submittal

1. Submit bid in a sealed opaque envelope. Identify the envelope with: A) Project Name; B) Name of Bidder; C) Registered Virginia Contractor Number; D) Bid Date. If bids are forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in the Form of Proposal with the notation "BID ENCLOSED" on the face thereof.

K. Modification and Withdrawals

1. Modification of bids already submitted will be considered if delivered prior to the time fixed for opening of bids. Written modifications may be delivered by mail or by the bidder personally or his properly identified representative or messenger. Telephonic and FAX modifications will not be considered. Modifications shall not reveal the original or revised bid. Delivery of modifications shall be the responsibility of the bidder.

L. Negotiation with Lowest Responsive and Responsible Bidder

1. The Public Body may negotiate with the apparent low bidder in accordance with Title 2.2, Chapter 43, Part 18 of the Virginia Public Procurement Act.

M. Withdrawal of Bid Due to Error

1. A bidder may withdraw his bid from consideration in accordance with Virginia Code Title 2.2, Chapter 43, Part 30 of the Virginia Public Procurement Act.

N. State Sales Tax

1. Bidders should be aware of the sales tax as applicable to the State of Virginia.

O. Opening

1. Bids will be opened as called for in the Invitation to Bid.

P. Award

1. The contract will be awarded to the lowest responsible bidder complying with the conditions of the Form of Proposal. The lowest bid does not refer to the lowest base bid, but the lowest total bid comprising the base bid plus or minus any/or all alternate bid items accepted, and not necessarily in the order in which they appear in the Form of Proposal.

Q. Execution of Contract

1. The Owner reserves the right to accept any bid and to reject any and all bids, and to waive any irregularities or informality in bids received whenever such waiver or rejection is in his own best interest.

2. Each bidder shall be prepared, upon written notice of bid acceptance, to commence work within fifteen (15) days following receipt of official written order from the Owner to proceed, or on date stipulated in such order.

3. The accepted bidder shall assist and cooperate with the Owner in preparing the Formal Contract Agreement between Owner and Contractor, Stipulated Sum, A.I.A. Document A101, 2017 Edition, and within fifteen (15) days following its presentation shall execute same and return it to the Architect/Engineer for distribution to Owner.

R. State of Virginia Requirements

The Code of Virginia, Title 2.2, Chapter 43, Part 11 requires each contract for more than \$10,000 to include provisions 1 and 2 below:

1. During the performance of this contract, the Contractor agrees as follows:
 - a. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin, except where religion, sex or national origin is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of the nondiscrimination clause.
 - b. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.
 - c. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

2. The Contractor will include the provisions of the foregoing paragraphs a, b, and c in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor. (1982, C. 647.)

SCC Registration

The SCC Registration requirement (attached to Form of Proposal) shall apply to this project.

S. Federal Requirements

1. No contractor or subcontractor shall, during the performance of this contract, knowingly employ an unauthorized alien, as defined by the Federal Immigration Reform and Control Act of 1986.

T. County, Virginia Public Schools Requirements

1. Criminal Background Certification. See Form of Proposal.

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

FACILITY RENOVATION PULASKI COUNTY INDOOR SPORTSPLEX AND EXPO CENTER

A. Pursuant to and in accordance with your "Invitation to Bid" and "Instructions to Bidders" relating thereto, the undersigned agrees to furnish all labor and materials and to perform all work necessary for construction of **FACILITY RENOVATION PULASKI COUNTY INDOOR SPORTSPLEX AND EXPO CENTER**, Pulaski County Parks and Recreation, in accordance with the contract documents (drawings, specifications and addenda) as prepared by ZMM ARCHITECTS ENGINEERS, dated April 10, 2025 for the lump sum price of:

BASE BID (Includes all allowance as indicated on page 2 of Section 012100 "Allowances" paragraph 1.7, of the project manual and replacement of 15% of Office Area SATC as indicated on drawings):

_____ Dollars (\$ _____).

UNIT PRICES

The bidder shall submit unit prices in the following schedule for all items listed below.

The following unit prices shall be used in determining additions to or deductions from the contracts when authorized changes in the work are directed. They shall apply when such changes involve materials, specifications, methods, and designs the same as those required in similar work and/or specified. Unit prices shall include the furnishing of all labor and materials, complete in place, and overhead and profit, unless otherwise noted. Unit prices provided shall apply to any project bid, unless otherwise specified.

	Addition/Deduction (Same Value)
A. Suspended Acoustical Tile Ceiling (SATC)	\$_____ per square. ft.

In submitting this bid, I agree:

1. To hold my bid valid for a period of sixty (60) days.
2. To accept the provisions of the Instructions to Bidders regarding disposition of bid security.
3. To enter into and execute a contract, if awarded on the basis of this bid, and to furnish performance bond and payment bond in accordance with Article 11.1.2 of AIA A201- General Conditions of the Contract for Construction.
4. To accomplish the work in accordance with the contract documents.
5. That I have examined the contract documents and the site.
6. If awarded contract on Base Bid, I (we) agree to perform the work to substantial completion by **May 15, 2026**. The Bidder understands that the Owner may retain a sum as set forth in Section 011000 - "Summary of the Work," for each day thereafter, Sundays and holidays included, that the Work remains uncompleted, such sum is agreed upon as the proper measure of liquidated damages which the Owner will sustain per diem by the failure of the Contractor to complete the Work in the stipulated time, and the sum is not to be construed in any sense a penalty.

The names of all subcontractors as listed below are required to be submitted to the Architect/Engineer's office within two business days after the bids are due.

Subcontractors for the following work shall be as listed (**Note:** List only **one** for each category):

Athletic Flooring: _____

Electrical: _____

Mechanical: _____

Addenda can be retrieved via ShareFile.

I acknowledge access to the following addenda:

Number _____ Dated _____

Number _____ Dated _____

Number _____ Dated _____

Number _____ Dated _____

The successful vendor certifies that the vendor, all principals and subrecipients, are not suspended or debarred from providing the services described in this contract. Further, Pulaski County Parks and Recreation reserves the right to review the List of Parties Excluded From Federal Procurement or Nonprocurement Programs to determine that the successful vendor, including all principals and subrecipients, has not been suspended or debarred from providing the services described in this contract.

CRIMINAL BACKGROUND CERTIFICATION

The Contractor shall provide certification that he or she has not been convicted of a felony or any offense involving the sexual molestation or physical or sexual abuse or rape of a child and whether he or she has been convicted of a crime of moral turpitude. To protect the safety of students and school employees, Contractor certifies to the School Board that none of Contractor's employees, whether new or current, full-time or part-time, permanent or temporary, who will be present on the Site or other school property and may have any contact with students or school employees, (i) have been convicted of a felony, any offense involving sexual molestation, physical or sexual abuse or rape of a child, or a felony involving lying, cheating or stealing; or (ii) have been the subject of a founded case of child abuse or neglect.

Contractor shall conduct an investigation of the criminal history, sex offender status and agency determinations of child abuse of each employee who will be present on the Site or other school property and may have contact with students or school employees. Contractor shall conduct all such investigations with the written consent of affected employees and in compliance with all applicable laws. Contractor certifies that it has conducted such an investigation for all current employees who will be involved in the work to be performed pursuant to this Agreement, and will conduct such an investigation for any future employees who will be involved in the Work to be performed pursuant to this Agreement. Contractor shall keep records of all investigations and shall make such records available to the School Board upon request.

If any employee of Contractor who will be present on the Site or other school property and may have contact with students or school employees is arrested for, charged with, or convicted of any such offense, or becomes the subject of a child abuse investigation, Contractor shall notify the Superintendent of the arrest, charge, conviction or investigation within forty-eight (48) hours after Contractor is made aware of the arrest, charge, conviction or investigation. The School Board reserves the right to exclude such employee from positions that may involve contact between such employee and students or school employees, or to exclude such individual from school property entirely.

Contractor shall include the provisions regarding criminal background certifications in all contracts with its subcontractors who will provide goods or services for GCPS, if any, so that such provisions are binding on all such subcontractors of Contractor.

Failure by Contractor or one of its subcontractors to conduct investigations or to make the certifications required by this provision may constitute a breach of this Agreement and grounds for termination or rescission of the Agreement. (Code of Virginia ' 22.1-296.1)

The following (attached) must be completed and attached as a part of this Form of Proposal:

SCC REGISTRATION REQUIREMENTS

Registered as a contractor under Title 54.1, Chapter 11, Code of Virginia

State Registration Number_____

Name of Firm

Address

Address

Legal Name of Corporation

State of Incorporation

By_____ (Officer Authorized Signature)

By_____ (Printed Name)

Title_____

Date_____

Phone_____

Email_____

Federal Tax ID #_____

GILES COUNTY PUBLIC SCHOOLS

151 School Road
Pearisburg, Virginia 24134
Phone: (540) 921-1421

Compliance with Virginia Law for Transacting Business in Virginia.

The undersigned hereby agrees, if this Bid/Proposal is accepted by GCPS, for such services and/or items that the undersigned has met the requirements of the Virginia Code Section 2.2-4311.2

Please complete the following by checking the appropriate line that applies and providing the requested information:

- A.** Bidder/offeror is a Virginia business entity organized and authorized to transact business in Virginia by the SCC and such bidder's/offeror's Identification Number issued to it by the SCC is _____. **(The SCC number is NOT your federal ID number).**
- B.** Bidder/offeror is an out-of-state (foreign) business entity that is authorized to transact business in Virginia by the SCC and such bidder's/offeror's Identification Number issued to it by the SCC is _____.
- C.** Bidder/offeror does not have an Identification Number issued to it by the SCC and such bidder/offeror is not required to be authorized to transact business in Virginia by the SCC for the following reason(s):

Please attach additional sheets of paper if you need to explain why such bidder/offeror is not required to be authorized to transact business in Virginia.

Legal Name of Company (as listed on W-9)

Legal Name of Bidder

Date

Authorized Signature

Print or Type Name and Title

VIRGINIA STATE CORPORATION COMMISSION (SCC)
INFORMATION REQUIRED

The attention of each Bidder is directed to Virginia Code Section 2.2-4311.2 (effective July 1, 2010) which requires a bidder or offeror organized or authorized to transact business in the Commonwealth of Virginia pursuant to Title 13.1 or Title 50 of the Code of Virginia, as amended, or as otherwise required by law, shall include in its bid or proposal the Identification Number issued to such bidder or offeror by the Virginia State Corporation Commission (SCC).

Furthermore, any bidder or offeror that is not required to be authorized to transact business in the Commonwealth of Virginia as a domestic or foreign business entity under Title 13.1 or Title 50 or as otherwise required by law shall include in its bid or proposal a statement describing why the bidder or offeror is not required to be so authorized.

For more information and answers to your questions please contact the Virginia State Corporation Commission (SCC). Website: <http://www.scc.virginia.gov/index.aspx>

SCC General Information

804-371-9967

Frequently Asked Questions: <http://www.scc.virginia.gov/clk/befaq/forinva.aspx#a1>

Email: sccinfo@scc.virginia.gov

Contact Information: <http://www.scc.virginia.gov/contact.aspx>

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

A. General

1. The "Standard Form of Agreement Between Owner and Contractor", A.I.A. Form A101, 2017 Edition, of the American Institute of Architects, is a part of this Project Manual to the same extent as if bound herein. Copies of this document may be inspected at or received from the office of the Architect/Engineer upon request.

CONTRACTOR'S POLICY OF NONDISCRIMINATION

Pursuant to Section 2.2-4311 of the 1950 Code of Virginia, as amended:

1. During the performance of any contract awarded, the contractor agrees as follows:
 - a. The contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.
 - b. The contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such contractor is an equal opportunity employer.
 - c. Notices, advertisements and solicitation placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.
2. The contractor will include the provisions of the foregoing paragraphs a, b and c in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.

Signature of Authorized Agent

Date

DRUG FREE WORKPLACE MAINTENANCE BY CONTRACTOR

Pursuant to Section 2.2-4312 of the Code of Virginia, all public bodies shall include in every contract over \$10,000 the following provisions:

During the performance of this contract, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a contractor in accordance with this chapter, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

Signature of Authorized Agent

Date

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

A. General

1. The "Performance Bond", A.I.A. Form A312, 2010 Edition, of the American Institute of Architects, is a part of this Project Manual to the same extent as if bound herein. Copies of this document may be inspected at or received from the office of the Architect/Engineer upon request.

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

A. General

1. The "Payment Bond", A.I.A. Form A312, 2010 Edition, of the American Institute of Architects, is a part of these specifications to the same extent as if bound herein. Copies of this document may be inspected at or received from the office of the Architect/Engineer upon request.

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

A. General

1. The "Bid Bond", A.I.A. Form A310, 2010 Edition, of the American Institute of Architects, is a part of this Project Manual to the same extent as if bound herein. Copies of this document may be inspected at or received from the office of the Architect/Engineer upon request.

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

A. General

1. The "Supplemental Attachment for Accord Certificate of Insurance", A.I.A. Form G715, 2017 Edition, of the American Institute of Architects, is a part of this Project Manual to the same extent as if bound herein. Copies of this document may be inspected at or received from the office of the Architect/Engineer upon request.

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

A. General

1. The "General Conditions of the Contract for Construction", A.I.A. Form A201, 2017 Edition, of the American Institute of Architects, is a part of these specifications to the same extent as if bound herein. Copies of this document may be inspected at or received from the office of the Architect/Engineer upon request.

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

01. General Conditions:

The "General Conditions of the Contract for Construction", A.I.A. Document A201-2017, Articles 1-15, inclusive, are a part of the contract and are incorporated herein.

02. Supplements:

The following supplements modify, change, delete, or add to the General Conditions. Where any part of the General Conditions are modified or voided by these articles, the unaltered provisions of that part shall remain in effect.

ARTICLE 1 - GENERAL PROVISIONS

1.5.2 Change "pursuant to Sections 1.7 and 1.8" to read "pursuant to Section 1.7"

1.7 Delete 2nd sentence.

1.7.1 New Subparagraph: "Use of ZMM ARCHITECTS ENGINEERS Document Management System Required:

- .1 The Contractor shall use the internet-based document management system prescribed by ZMM. Currently, this system is ShareFile, and its use and access by the Contractor is free of charge. At its sole discretion, ZMM may change document management systems prior to final ratification of the Contract for Construction. Any document management software will be free of charge for the Contractor to access and use. The Contractor may also grant access to the document management system, free of charge, to their subcontractors, suppliers, etc.
- .2 The Contractor shall utilize the document management system for the following tasks throughout the project:
 - .a All submittals to ZMM. This includes, but may not be limited to shop drawings, schedules, field reports, cost proposals, formal project correspondence, RFIs, CCDs, etc.
- .3 ZMM will provide a user guide with specific requirements and instructions. The Contractor may request a copy of this document from ZMM prior to bid."

1.8 Delete in its entirety.

ARTICLE 2 - OWNER

2.3.6 Delete in its entirety and substitute the following:

"Drawings, specifications, and addenda will be provided to the Contractor in digital format via ShareFile. The Contractor will be responsible for printing his/her own drawings, specifications, and addenda for execution of the work."

ARTICLE 3 - CONTRACTOR

3.2.5 New Subparagraph: "Should conflict occur in Contract Documents and the Bidder does not ask for and obtain a written decision, before submission of bid, as to which method or material will be required, then it shall be deemed that the Bidder has based his bid on the more expensive way of performing the work."

3.7.4 Delete in its entirety.

3.8.2 Item .2 change to read - "Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the allowances; and"

3.9 Superintendent

3.9.4 New Subparagraph: "The Contractor's superintendent shall give special attention to all phases of work nearing completion, and shall remain on the job site, in active control of work, until all phases of the work have been completed, tested, cleared, and accepted by the Owner or his representative. The superintendent shall not be a foreman and shall not perform or supervise any manual labor. The superintendent shall have 10 years experience as a superintendent."

3.9.5 New Subparagraph: "Should the superintendent at any time, in the opinion of the Architect/Engineer or Owner, fail to perform his duties satisfactorily, he shall be removed from the project upon request of the Architect/Engineer and a suitable replacement employed. The replacement shall be approved by the Owner and the Architect/Engineer."

3.9.6 New Subparagraph: "The Contractor shall have on-site, for the duration of his work, a competent superintendent capable of the following:

- .1 Supervising the tradesmen and any subcontractors.
- .2 Reading and interpreting the Contract Documents.
- .3 Orderly coordination of his work with the Architect/Engineer in the daily execution of The Work.
- .4 Laying out his work.
- .5 Representing the Contractor with the Owner and Architect/Engineer in the daily execution of The Work.
- .6 Controlling and establishing good quality in the completed work.
- .7 A resumé on the Contractor's proposed superintendent must be submitted to and approved by the Owner and the Architect/Engineer prior to assignment to the project.
- .8 After acceptance of the Contractor's superintendent, he may not be transferred from this project without written permission from the Architect/Engineer."

3.9.7 New Subparagraph: "The Superintendent employed by the Contractor shall have a minimum of ten (10) years successful commercial experience as the primary Superintendent on projects of similar size and complexity as the Work. The Contractor shall submit to the Architect a resume and other supporting documentation showing that the proposed Superintendent is competent and has the minimum work experience required to execute the Work. The Owner reserves the right to request additional supporting documentation regarding the proposed Superintendent's qualifications and to require the Contractor to propose an alternate

Superintendent who better meets the requirements contained in this Article, as may reasonably be determined by the Owner. The Contractor shall notify the Architect and Owner in writing of any proposed replacement of the Superintendent. The Contractor shall not replace a competent Superintendent without prior or written approval from the Owner. The requirements contained in this Article shall apply to any proposed replacement Superintendent, regardless if the proposed tenure is to be temporary or permanent."

- 3.9.8 New Subparagraph: "The Contractor shall employ a Project Manager to be assigned to the Work. The Project Manager employed by the Contractor shall have a minimum of ten (10) years successful commercial experience as Project Manager on projects of similar size and complexity as the Work. The Contractor shall submit to the Architect a resume and other supporting documentation showing that the proposed Project Manager is competent and has the minimum work experience required to execute the Work. The Owner reserves the right to request additional supporting documentation regarding the proposed Project Manager's qualifications and to require the Contractor to propose an alternate Project Manager who better meets the requirements contained in this Article, as may reasonably be determined by the Owner. The Contractor shall notify the Architect and Owner in writing, of any proposed replacement of the Project Manager. The Contractor shall not replace a competent Project Manager without prior written approval from the Owner. The requirements contained in this Article shall apply to any proposed replacement Project Manager, regardless if the proposed tenure is to be temporary or permanent. The Project Manager shall not act as the Superintendent or replacement for the Superintendent without written approval from the Owner."

3.10 **Contractor's Construction and Submittal Schedules**

- 3.10.4 New Subparagraph: "Within fifteen (15) business days of award of the contract, the Contractor shall submit a Construction Schedule to the Architect and Owner for review. The Architect and Owner shall review the schedule and offer any comments they have in writing within ten (10) business days. Such review and comments shall be for informational purposes only and shall not constitute endorsement of any errors or omissions that may appear in the schedule, nor shall it constitute a review of the Contractor's means and methods.

The Construction Schedule shall be a comprehensive, fully developed, horizontal Gantt chart type. The schedule shall begin at the Notice to Proceed date and end no later than the contractual date of completion. Contract date shall not be changed by submission of a schedule that shows an early completion date.

- .1 Activities: At a minimum, the schedule shall show the following:
 - .a Activity Duration: Define activities (tasks) so no activity duration is longer than twenty (20) days.
 - .b Procurement Activities: Include procurement activities as separate activities in the schedule. Procurement activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - .c Submittal Review Time: Include review and at least one resubmittal into the schedule for each submittal listed on the Submittal Log in the specifications. Review periods shall be the maximum time allowed by the specifications. There shall be no time extensions granted for submittals that require more than one resubmittal.
 - .d Startup, Balancing, Testing and Commissioning Activities: Indicate all activities associated with systems and equipment Startup, Balancing, Testing and Commissioning, including training of Owner's personnel. Each system

and piece of equipment subject to these activities shall be represented as a separate activity in the schedule.

- .e Punch Lists, including Above Ceiling Inspections: Indicate punch lists as milestones in the schedule. Include separate activities for completing punch list work within time limits prescribed by the Contract Documents.
- .f Substantial Completion: Indicate completion in advance of date established for Substantial Completion, allowing time for Architect's administrative procedures necessary for certification of Substantial Completion.
- .g Final Completion: Indicate time for punch list work, submittals and administrative procedures between Substantial Completion and Final Completion.
- .2 Constraints: Include constraints and work restrictions indicated in the Contract Documents, including the prescribed Monday-Thursday work week and Friday make-up day.
- .3 Critical Path: Indicate the critical path tasks throughout the project. Alert the Owner and Architect if the critical path changes and why it changed.
- .4 Float: Indicate float for each activity. The project owns the float and it may be used by either the Contractor, the Owner, or the Architect without affecting the critical path, and without penalty.
- .5 Percent Complete: Indicate percent complete for all activities."

3.10.5 New Subparagraph: "For purposes of calculating the additional days due to inclement weather, the normal work week for this project will be Monday through Thursday, 10 hours per day. Starting and quitting times will be established at the first jobsite meeting. Friday will be used as a makeup day for any time lost during the week due to inclement weather or other progress delays. Any Contractor working extended additional hours in a particular week due to his work being behind will be responsible for any overtime costs incurred by the Owner and the Clerk-of-the-Works, who may be required to work these extended hours to support his work. Delays due to a single weather day experienced Monday through Thursday will not be allowed if Friday is utilized or could have been utilized as a makeup day."

3.11 **Documents and Samples at the Site**

Delete "upon completion of the Work" and insert "prior to final payment".

3.12 **Shop Drawings, Product Data and Samples**

3.12.11 New Subparagraph: "Shop drawings and samples shall be dated and shall contain: name of project, description or names of equipment, materials and items, and complete identification of locations at which materials or equipment are to be installed. Cut sheets of materials showing items to be used shall be submitted."

3.12.12 "Unless otherwise specified, electronic shop drawing submittals are preferred, but if hard copies are submitted, the number of shop drawings, product data, and the number of samples which the Contractor shall submit and, if necessary, resubmit, is the number that the Contractor requires to be retained, plus **one** which will be retained by the Architect/Engineer, plus **two** that will be retained by the Owner."

3.15 **Cleaning Up**

3.15.3 New Subparagraph: "Clean all areas affected by the work to the satisfaction of the Owner. Remove broken or scratched glass and replace with new glass. Remove paint droppings, spots,

and dirt from finished surfaces. Clean plumbing fixtures, hardware, floors, electrical switches and switchplates, and equipment. Contractor shall keep interior of the building free of stored or unattended combustible materials. All glass shall be cleaned 5 days before acceptance by the Owner."

ARTICLE 4 - ARCHITECT

4.2.2 Add the following sentence:

"The Contractor shall reimburse the Owner for compensation paid to the Architect for additional site visits made necessary by the fault, neglect or request of the Contractor."

4.2.8.1 New Subparagraph: "No change in the work will give rise to an increase in the contract sum without a change order, and the Contractor waives any claim for such an increase based upon unjust enrichment, course of dealings or implied or express acceptance."

ARTICLE 7 - CHANGES IN THE WORK

7.2 **Change Orders**

7.2.2 New Subparagraph: "In subparagraphs 7.1.1, 7.1.2 and 7.1.3, the allowance for overhead in direct labor cost shall be 46.7% (FICA, FUI, SUI, Workmen=s Compensation, Vacation, Holidays, Sick, Health Insurance, Life Insurance, 401K); the allowance for overhead in direct material and equipment cost shall be the current sales tax where the project is located; the allowance for overhead and profit combined, included in the total cost to the Owner, shall be based upon the following schedule: For the Contractor, for work performed by his own forces, 20% of the cost; for the Contractor, for work not performed by his own forces, 10% of the cost; for subcontractors, for work performed by his own forces, 20% of the cost. Cost to which overhead is applied shall be limited to the following: cost of materials, including sales tax and cost of delivery; cost of labor, including social security, and unemployment insurance (labor cost may include a pro rata share of foreman's time only in the case where an extension of contract time is granted due to the change), workman's compensation insurance, vacation, holidays, sick, health insurance, life insurance, and 401K, rental value of special power tools and equipment required specifically for this work. Rental of tools and equipment required for general work can be charged only in the case where an extension of contract time is granted due to the change. Overhead shall include the following: bond premiums, supervision, superintendence, wages of timekeepers, watchmen and clerks, small tools, incidentals, general office expenses, and all other expenses not included in "cost". If the net value of a change results in a credit from the Contractor or subcontractor, the credit given shall be the net cost plus overhead and profit. The cost as used herein shall include all items of labor, materials, and equipment."

7.3.1 Delete in its entirety and substitute the following:

"Construction Change Directives (CCD) - A Construction Change Directive is a written request for pricing from the Architect or, when signed by the Owner, a directive to carry out the work prescribed by the CCD. The Owner, by Construction Change Directive, without invalidating the Contract, orders changes in the work within the general scope of the contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly by Change Order at a later date. The Owner may sign the CCD, ordering the work to commence, as prescribed in Item 1. or 2. below:

1. Upon receipt of and agreement to the Contractor's proposed cost/credit and/or adjustment of Contract Time. The Architect has the authority to request cost and time proposals of the Contractor without written consent of the Owner, however, the Owner's signature is required on the CCD as authorization for the work to proceed.
2. The Architect and Owner may both sign a CCD to direct the Contractor to proceed with work immediately. Costs and time will be negotiated and agreed to at a later date.

When a CCD is issued by the Architect to request pricing, the Contractor shall submit cost and time proposals within ten (10) business days of the date of the CCD. If work prescribed by the CCD may immediately impact the critical path, the Contractor shall notify the Architect and Owner immediately and shall submit the cost and time proposal in less than ten (10) business days, in order to mitigate or otherwise minimize the impact of the potential change on critical path activities. The Contractor shall track the cost and time proposal using the CCD number only.

The Contractor may initiate a Cost Proposal when he believes there is cause to do so. Contractor's cost proposals shall be tracked by sequential numbers preceded by "CP". The Architect will review and respond to the Contractor initiated cost proposals within ten (10) business days. Failure of the Contractor to submit a Contractor initiated cost proposal within thirty (30) calendar days of cause for the alleged cost shall render the claim for additional compensation null and void. Once the Architect agrees to the terms of a Contractor initiated Cost Proposal, he shall create a Construction Change Directive (CCD) and obtain Owner and Contractor signatures as formal approval of the terms of the Cost Proposal. In lieu of a CCD, the Architect may include Contractor initiated Cost Proposals in a Change Order, as incorporation into the Contract."

- 7.3.2 Add the following: "A Construction Change Directive may also be used in the absence of total agreement on cost and time, as provided in Paragraph 7.3.4."
- 7.3.6 Delete in its entirety.
- 7.3.7 Change last sentence to read as follows: "Such agreement shall be recorded at a later date as a Change Order."
- 7.3.10 Add the following to the last sentence: ", and may not be issued until later in the project if there exists a Contingency Allowance, or other allowances, from which to draw from for the cost of the Construction Change Directive."

ARTICLE 8 - TIME

- 8.3 **Delays and Extensions of Time** - Delete in its entirety and substitute the following:

"8.3 **Delays and Extensions of Time**

- 8.3.1 Contract time stipulated under other sections of the Contract Documents may be extended by Change Order to provide an additional work day for each full work day that the Contractor is prevented from working by reason of one or more of the following causes:
- .1 Unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not limited to, catastrophes and/or acts of God, acts of

- another Contractor in the performance of a separate contract with the Owner, epidemics, quarantine restrictions, strikes or freight embargoes;
- .2 An unusual amount of severe weather to such an extent as to be definitely abnormal and beyond conditions that may be reasonably anticipated. For the purpose of this contract, a total of three (3) working days per calendar month shall be anticipated as "normally bad or severe weather", and such time will not be considered justification for an extension of time: No weather delay extensions will be considered unless, in the opinion of the Architect/Engineer, the weather condition affected the critical path adequately to justify a delay;
- .a Claims for delay due to inclement weather shall be made by the 10th of the month following the month of the delay. No additional compensation for weather delays shall be granted.
 - .b Other claims shall be made no more than ten (10) calendar days after the commencement of the delay.
 - .c Claims made beyond these time limits shall be null and void.
 - .d Requests for extension of time shall be fully documented by including copies of daily logs, letters, shipping orders, delivery tickets, and other supporting information.
 - .e Normal working days are based on a four day week, Monday through Thursday, 10 hours per day.
 - .f Delays due to a single weather day experienced Monday through Thursday will not be allowed if Friday is utilized or could have been utilized as a makeup day.
- .3 All claims for delays shall be evaluated by the Architect using the most recent construction schedule in possession of the Architect at the time of the delay and a construction schedule revised by the Contractor, demonstrating the delay. The schedules must exhibit that the change, or weather, affected critical path tasks or used more than the available float for a task or tasks to justify an extension in contract time.
- .4 Where phased construction is prescribed by the Contract Documents, approved contract time extensions shall extend the duration of the phase in which the delay occurred. Durations of other phases will remain unchanged, and the dates of substantial and final completion shall be extended.
- .5 Stoppage of work, ordered by Owner or Architect/Engineer, for reasons over which Contractor has no control. The Contractor shall, within ten (10) days after the beginning of such delay notify the Owner and Architect/Engineer in writing of the cause of the delay. The Architect/Engineer will then ascertain the facts and extent of delay, and notify the Contractor within ten (10) working days of the Owner's decision in the matter. Notice of delay and requests for extension of time shall set forth the cause, and number of additional working days the Contractor desires the contract extended.
- .6 With the exception of overhead and profit allowed where changes in the work occur, no additional compensation will be allowed for time extensions.

- 8.3.2 No claims for extension of time will be considered when based on delays caused by conditions existing at the time bids were received, and of which the Contractor might be reasonably expected to have full knowledge at the time of bidding, or upon delays caused by failure on the part of the Contractor to anticipate properly the requirements of the work contracted for as to materials, labor and equipment. All claims for extension of time shall be made in writing to the Architect/Engineer within the time limits prescribed by the Contract Documents; otherwise they shall be waived.
- 8.3.3 Completion date stipulated under other sections of the Contract Documents may be extended by Change Order to compensate for additional work that may be ordered by the Owner,

provided such work is over and beyond the scope of work covered by original contract, and is of such nature as to materially affect the date of completion."

ARTICLE 9 - PAYMENTS AND COMPLETION

9.3 Applications for Payment

9.3.4 New Subparagraph: "Amount payable monthly to be ninety-five percent (95%) of amount of work in place, or materials stored on the site on the first day of the month. If the Contractor is behind schedule, or there are quality problems, the Owner may retain up to 10%. The retainage may not be reduced or released by the Owner until the project is fully completed and accepted by the Owner."

9.5 Decisions to Withhold Certification

9.5.1 Add the following:

".8 if the construction schedule is not properly maintained and/or if revised construction schedules are not submitted to the Owner and the Architect at least twice monthly, coinciding with progress meetings unless otherwise agreed upon by the Owner and Architect.

.9 failure to process Construction Change Directives, Change Orders, Shop Drawing submittals, or other material associated with the Contract for Construction within time limits established by the Contract Documents, or if no time limits are established, within a reasonable amount of time to avoid delays and allow sufficient review time for the Owner and Architect."

9.5.3.1 New Subparagraph: "The Owner shall not be in breach for withholding payment so long as it does so in good faith based upon a bona fide dispute. The Contractor may not stop work during the pendency of a bona fide dispute. Until the dispute is resolved, the associated sum shall be placed in escrow."

9.9 Partial Occupancy or Use

9.9.1.1 New Subparagraph: "When the Contractor is ready for final inspection, he shall give notice to the Architect/Engineer, with a copy to the Owner in the following words:

"The work on the contract for (show name of project as it appears in the Form of Agreement), having been fully completed, except as stipulated herein below, it is requested that a final inspection be made promptly by the Architect/Engineer. The following work is incomplete through no fault or negligence of the Contractor: (list any work the Contractor regards as exceptionable and after each item substantiate why its incompleteness is not due to his fault or negligence.)"

No final inspection shall be made until such time as the Architect/Engineer and the Owner have received a letter in the exact form indicated above."

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

10.3.3 Delete in its entirety.

Add the following new paragraphs:

"10.5 General

10.5.1 All phases of work under this contract shall conform to the applicable requirements of the Occupational Safety and Health Act (Public Law 91-596) as adopted by the U.S. Department of Labor."

ARTICLE 11 - INSURANCE AND BONDS

11.1 Contractor's Insurance and Bonds

11.1.1.1 New Subparagraphs: "The insurance required by subparagraph 11.1.1 shall be written for not less than any limits of liability required by law or by those set forth below, whichever is greater, and shall include contractual liability insurance as applicable to the Contractor's obligations under paragraph 3.18.

.1 The Contractor's comprehensive general liability insurance and automobile liability shall be in an amount not less than one million dollars (\$1,000,000) for injuries, including accidental death, to any one person and subject to one million dollars (\$1,000,000) on account of one occurrence.

.2 Property damage liability insurance shall be in an amount not less than fifty-thousand dollars (\$50,000).

.3 Liability insurance should include all major divisions of coverage and shall be on a comprehensive general basis, including:

.1 Premises - Operations (Including X-C-U)

.2 Owner's and Contractor's Protective

.3 Products and Completed Operations

.4 Contractual - Including specific provision for the Contractor's obligations under paragraph 3.18."

11.1.2.1 New Subparagraph: "The successful bidder, if awarded the contract, shall provide a proper performance and payment bond, covering up to the full amount of the contract price as security for the faithful performance of all work under the contract and payment of all charges in connection therewith. Cost of said bond to be included in base bid. The failure of the bidder to whom the award is made to execute the agreement and supply the required bonds within fifteen (15) days after award of contract or within such extended period as the Owner may grant, shall constitute a default and the Owner may award the next lowest bidder in succession and charge against the defaulting bidder the difference up to the total amount of the bidder's bid security."

11.1.3 Delete in its entirety and substitute therefore: "Furnish in duplicate, certificates herein called for and specifically set forth, evidence of all coverage required by 11.1.1 and 11.1.1.1 and the Contractor shall furnish to the Architect/Engineer copies of any endorsement that is subsequently issued amending coverage or limits."

11.2 Delete in its entirety.

11.5.2 Delete beginning with 4th sentence through the end of the paragraph.

Add the following new paragraphs:

"11.6 **Construction Property Insurance (Builders Risk)**

11.6.1 Unless otherwise provided in the Special Conditions, the Owner agrees to include the interest of the Owner, Contractor(s), subcontractors, and sub-subcontractors in an insurance policy covering all loss to the work, materials, and equipment by perils covered under the "Special" Property form, including theft, malicious mischief and vandalism. The policy will be written by an insurance company licensed to issue such policies in the **State of Virginia**. The Contractor will be furnished a copy of the Certificate of Insurance after the Contract is executed. The Owner will purchase, pay for, and maintain this insurance throughout the life of this Contract, and therefore, the cost of Builders Risk Insurance shall not be included in the Contractor's bid.

11.6.2 The insurance to be furnished by the Owner will cover only those materials and equipment which will become a permanent part of the completed project and scaffolding, construction forms and temporary structures if their values are chargeable to the project.

11.6.3 The amount of the insurance provided hereunder shall be at all times at least equal to the full value of the work, material and equipment complete and in place (as part of the permanent project) and the value of material and equipment delivered to the site or approved off-site storage locations.

11.6.4 The insurance to be provided hereunder shall include coverage for materials and equipment accepted for incorporation into the completed project and stored on the site of the work, stored in an off-site location which has been approved by the Owner, or in transit.

11.6.6 Following any loss which the Contractor believes may be covered by the insurance to be provided hereunder, the Contractor shall immediately notify the Owner. The Owner will report to the insurance company losses on behalf of the Contractor. The Contractor shall cooperate with the Owner and the insurer, or its authorized representatives, in their efforts to investigate and settle the claim, including providing any and all requested information, documentation and reports and providing safe access to the site for inspection. Contractors' failure to provide timely notification of loss to the Owner, or Contractors' failure to provide requested and adequate information or documentation, shall not prejudice the Owner in any manner whatsoever.

11.6.6.1 The Contractor is responsible for notifying law enforcement or other applicable authorities in the event of a loss and for compiling all pertinent and required information in a timely manner.

11.6.6.2 Following a loss, the Contractor shall immediately take all necessary and reasonable steps to protect the property from further damage or loss.

11.6.6.3 All costs incurred by the Contractor associated with the loss not covered by the loss settlement shall be borne by the Contractor.

- 11.6.7 Any loss insured under the policy to be provided hereunder shall be adjusted with the Owner and made payable to the Owner as trustee for the insureds, as their interests may appear. The proceeds of any insured loss shall be credited to the Capital Project account of which the Contract is funded and shall be distributed in accordance with such agreement as the parties in interest may reach. Actual disbursement of insurance proceeds in the agreed upon amounts shall be made by the Owner to the Contractor(s) in accordance with the prevailing standard procedures of the Owner' Business Office.
- 11.6.8 The Owner reserves the right to choose and determine the manner in which any damaged work covered by the insurance provided hereunder shall be replaced or repaired and the extent to which replacement or repair shall be accomplished. In the event the Owner chooses not to replace or repair damaged work, or chooses to have repairs or replacement accomplished by others, the Contractor(s) shall be paid in full by the Owner for the actual value of all work accomplished on the affected portion of the damaged facility prior to the time of the loss. The Contractor(s) shall not have any claim or be entitled to any payment, including loss of profit, for the value of lost or uncompleted work. Nor shall the provision in any way release the Contractor or the Contractor's surety from obligations under the Contract to fully complete the undamaged portions of the project. In the event the Owner chooses to have the repair or replacement of the damaged work performed under this Contract, said work shall be paid for and accomplished in accordance with the Change Order provisions of this Contract.
- 11.6.9 The Owner and the Contractor waive all rights against each other and the subcontractors, sub-subcontractors, officers, agents and employees of each other for damages caused by insured perils to the extent covered by the insurance provided hereunder, except such rights as they may have to the proceeds of such insurance held by the Owner as trustee.
- 11.6.10 If the Owner chooses to occupy or use a portion or portions of the work prior to substantial completion thereof, such occupancy shall not commence prior to a time mutually agreed to by the Owner and Contractor(s) and to which the insurance company or companies providing the Property Insurance have consented by endorsement to the policy or policies. The insurance provided hereunder shall not be canceled or lapsed on account of such partial occupancy. Consent of the Contractor(s) and of the insurance company or companies to such occupancy or use shall not be unreasonably withheld.
- 11.6.11 The Owner makes no guarantee, expressed or implied, in providing the hereunder described Property Insurance, that said Insurance will cover any and all losses to the complete satisfaction of the Contractor(s) nor shall the Owner be under any obligation whatsoever to make good any loss or portion of loss not covered by said Insurance.
- 11.6.11.1 The Owner assumes no liability, and the Contractor shall have no claim against them for the amount of loss claimed by the Contractor which exceeds the actual proceeds received from the Insurance provided hereunder. The Contractor shall have no claim against the Owner for any loss caused by perils not covered by the Insurance provided by the Owner hereunder, nor shall the Contractor have any claim against them for any loss to Contractor's materials, tools, equipment or personal property not covered by the said Insurance.
- 11.7 **Indemnification**
- 11.7.1 The Contractor shall indemnify, protect, defend and hold harmless the Owner, their agents and employees from and against any and all claims, demands, judgments, or causes of action, including costs and attorney's fees by any party or parties whatever for loss, damage, injury, fines or penalties of any kind or character either to persons or property directly or indirectly

arising out of the operations performed under the Contract except such loss, damage or injury as is caused by the sole negligence of the Owner. This indemnity agreement shall impose liability on the Contractor to the fullest extent permitted by the laws of the state governing performance thereof, and any provision hereof not permitted by such laws is expressly deleted from said agreement.

11.7.2 "Injury" or "damage" as these words are used in the foregoing paragraph, shall be construed to include, but not be limited to, injury or damage consequent upon the failure of or use or misuse by the Contractor, his subcontractors, agents or employees in providing supervisory, inspection or engineering services or of any design, application, professional advice or opinion rendered to the Owner or on the Owners' behalf as well as any substance, material, machinery, hoist, rigging, block, scaffolding, or any and all kinds of equipment whether or not owned, furnished or lent by the Owner.

11.7.3 The purchase of insurance by the Contractor shall in no event be construed as a fulfillment or discharge of the obligations set forth in this section."

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1 Delete 2nd sentence in its entirety.

Add the following new paragraphs:

13.6 Legally Required Provisions

13.6.1 The Code of Virginia, Title 2.2, Chapter 43, Part 11 requires each contract for more than \$10,000 to include provisions 1 and 2 below:

.1 During the performance of this contract, the Contractor agrees as follows:

.a The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin, except where religion, sex or national origin is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of the nondiscrimination clause.

.b The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.

.c Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

.2 The Contractor will include the provisions of the foregoing paragraphs a, b, and c in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor. (1982, c. 647.)

13.6.2 All public bodies shall include in every contract over \$10,000 the following provisions:

- .1 During the performance of this contract, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.
- .2 For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a contractor in accordance with this chapter, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract. 2000, c. 417, § 11-51.1; 2001, c. 844.

13.6.3 Any contract awarded by any state agency, or any contract awarded by any agency of local government in accordance with § 2.2-4352, shall include:

1. A payment clause that obligates the contractor to take one of the two following actions within seven days after receipt of amounts paid to the contractor by the state agency or local government for work performed by the subcontractor under that contract:
 - a. Pay the subcontractor for the proportionate share of the total payment received from the agency attributable to the work performed by the subcontractor under that contract; or
 - b. Notify the agency and subcontractor, in writing, of his intention to withhold all or a part of the subcontractor's payment with the reason for nonpayment.
2. A payment clause that requires (i) individual contractors to provide their social security numbers and (ii) proprietorships, partnerships, and corporations to provide their federal employer identification numbers.
3. An interest clause that obligates the contractor to pay interest to the subcontractor on all amounts owed by the contractor that remain unpaid after seven days following receipt by the contractor of payment from the state agency or agency of local government for work performed by the subcontractor under that contract, except for amounts withheld as allowed in subdivision 1.
4. An interest rate clause stating, "Unless otherwise provided under the terms of this contract, interest shall accrue at the rate of one percent per month."
5. Any such contract awarded shall further require the contractor to include in each of its subcontracts a provision requiring each subcontractor to include or otherwise be subject to the same payment and interest requirements with respect to each lower-tier subcontractor.

6. A contractor's obligation to pay an interest charge to a subcontractor pursuant to the payment clause in this section shall not be construed to be an obligation of the state agency or agency of local government. A contract modification shall not be made for the purpose of providing reimbursement for the interest charge. A cost reimbursement claim shall not include any amount for reimbursement for the interest charge.”

1990, c. 824, § 11-62.11; 1992, c. 110; 2001, c. 844.

ARTICLE 15 - CLAIMS AND DISPUTES

- 15.1.7 Delete in its entirety.
- 15.2.1 5th line, delete "mediation" and replace with "litigation".
- 15.2.5 Beginning on the 4th line, delete "The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution."
- 15.2.6 Delete "mediation" and replace with "litigation".
- 15.2.6.1 First sentence, delete "mediation" and replace with "litigation". 2nd sentence, delete "mediation" and replace with "litigation"; delete "mediate" and replace with "litigate".
- 15.3 Delete in its entirety.
- 15.4 Delete in its entirety.

PULASKI COUNTY PARKS AND RECREATION
FACILITY RENOVATION
PULASKI COUNTY INDOOR SPORTSPLEX
AND EXPO CENTER

SECTION 011000 - SUMMARY OF THE WORK

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 DEFINITIONS

- A. Whenever the term "Owner" is used in this specification or on the drawings, it refers to Pulaski County Parks and Recreation.
- B. Whenever the term "Architect/Engineer" is used in this specification, it refers to ZMM ARCHITECTS ENGINEERS, Blacksburg, Virginia, who by contract with the Owner is authorized to prepare all drawings and specifications and to administer the construction after award of the contract.
- C. Wherever the term "Contractor" or "General Contractor" is used in this specification, it refers to the contractor who by contract with the Owner is responsible for the furnishing of all labor and materials and performing all work as described herein.
- D. Wherever the term "existing" is used in this specification or on the drawing it refers to work that currently exists.
- E. "Provide" shall mean "provide new materials and installation, complete with all accessories, parts and/or services to be ready for its intended use".

1.3 WORK UNDER THIS CONTRACT

- A. The Pulaski Sportsplex project consists of various levels of interior renovation of approximately 162,370 SF. The facility will ultimately house indoor basketball courts, pickle ball courts, volleyball courts, futsal fields, indoor playground, etc. As part of the renovation, a new weight room, cardio room, seniors exercise room, VIP lounge, executive board room, catering kitchen and indoor golf simulation area shall be included. Exterior renovation will only include some minor finish upgrades. No parking or asphalt shall be part of this project.

1.4 WORK BY OWNER UNDER SEPARATE CONTRACTS

- A. The Owner will provide an on-site owner's representative (Clerk-of-the-Works). This will not eliminate the Contractor's responsibility for Quality Control as required in Section 014000, QUALITY REQUIREMENTS. The duties and responsibilities of the Clerk-of-the-Works are as follows:
 - 1. Observe the quality and progress of the construction to determine in general that it is proceeding in accordance with the Contract Documents. Notify the Architect/Engineer immediately if, in the Clerk-of-the-Works opinion, work does not conform with the Contract Documents or requires special investigation by the Architect/Engineer or Contractor, and document same in the Clerk-of-the-Works' Daily Report.
 - 2. Monitor the construction progress and assist in the preparation of progress reports.

3. Review Contract Documents with the Contractor's superintendent so as to have a complete understanding of the scope of the project.
4. Consider the Contractor's suggestions and recommendations, evaluate them, discuss them with the Architect/Engineer and assist the Architect/Engineer when applicable in making a final decision. Maintain liaison with the Contractor and all subcontractors on the project only through the Contractor's superintendent.
5. Attend project meetings as the Owner's representative and report to the Architect/Engineer in writing on the proceedings.
6. Observe tests at the project site which are required by the Contract Documents and report any oddities in the conduction of these tests to the Architect, outlining all details relative to the test procedures. Record the conditions and resolutions made by the Architect/Engineer in the Clerk-of-the-Works' Daily Report. Review testing invoices, if any, to be paid by the Owner.
7. Maintain records at the construction site in an orderly manner in accordance with the Architect/Engineer's procedures. Include correspondence where applicable, such as Contract Documents, Change Orders, Construction Change Authorizations, reports of site conferences, Shop Drawings, Product Data, Samples, supplementary drawings, color schedules, requests for payment, names and addresses of contractors, subcontractors and principal material suppliers. Maintain a complete copy of the original plans and specifications.
8. Keep a log book containing project progress and reports and submit reports on the progress of the Contractor's work to the Architect/Engineer noting conditions in the Clerk-of-the-Works Daily Report which may cause delay in completion. The log must contain activities related to the project, weather conditions, nature and location of work being performed, arrival of materials, visitors, and tests performed. The Project Architect/Engineer will provide Field Reports (observation reports) documenting his site visits.
9. Record and maintain a running record of outstanding, unresolved issues. The record shall include the issue, date of occurrence, and date of resolution. After an item is reported to be corrected, it shall be deleted from the list.
10. Report, in writing, to the Owner and A/E any notifications from the Contractor of dates and times that services will be disrupted.
11. Notify the A/E if work begins before required shop drawings, product submittals, or samples have been approved by the A/E. Receive and log samples required to be furnished at the site; notify the A/E when they are ready for examination; record the A/E's approval or other action; and maintain custody of approved samples.
12. If inspectors representing local, State, or Federal agencies having jurisdiction visit the site, accompany such inspectors during their trips through the project, record and report in the Clerk-of-the-Works' Daily Report the results of such inspections.
13. Observe the Contractor's Record Drawings at intervals appropriate to the stage of construction and notify the Architect/Engineer of any apparent failure by the Contractor to maintain up-to-date records.
14. Review Applications for Payment submitted by the Contractor with the Architect/Engineer and assist in making recommendations for disposition.
15. Assist the Architect/Engineer in reviewing the list of items to be completed or corrected which is submitted by the Contractor with a request for issuance of a Certificate of Substantial Completion. When applicable, assist the Architect/Engineer in reviewing the documentation and record documents to be furnished to the Owner by the Contractor at Substantial Completion, and verify that the Contractor has met the requirements of the Contract Documents for training the Owner's personnel in the operation and maintenance of all building equipment and systems.
16. Assist the Architect/Engineer in final inspection of the work. Assist the Architect/Engineer in reviewing the documentation and record documents to be furnished to the Owner by the Contractor upon completion of the work.

17. At no time shall the Clerk-of-the-Works assume responsibilities of the Architect/Engineer or Architect/Engineers representative. The Clerk-of-the-Works has limitations of authority and does not provide the following:
 - a. Issue change orders or direct the Contractor or any of his subcontractors to make changes to the original, approved plans and specifications.
 - b. Interpret plans and specifications for General Contractor or his subcontractors or expedite their work.
 - c. Interpret or advise the General Contractor or his subcontractors regarding Federal, State, or county regulations.
 - d. Assume any authority of or for the architects and engineers of this project.
 - e. Pass judgment on completeness or the lack of completeness of the Architect/Engineer's work on this project to the General Contractor, subcontractor, or any of their people.

1.5 CONSTRUCTION SCHEDULE

- A. Work shall commence immediately after “Notice to Proceed” issued on behalf of the Owner and Substantial Completion must be achieved by the agreed upon date and Bidder agrees to pay liquidated damages for each consecutive calendar day thereafter until achieving Substantial Completion.

1.6 CONTRACTOR USE OF SITE

- A. The Contractor shall limit his use of the site to the areas indicated under the Contract in order to allow for owner occupancy. Portions of the site beyond areas on which work is indicated are not to be disturbed.
- B. Keep existing roads and entrances serving the premises clear and available to the Owner and public at all times. Do not use these areas for parking or storage of materials without prior approval from the Owner.
- C. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of office, storage sheds, etc., to the areas agreed upon with the Owner.
- D. Lock automotive type vehicles, such as passenger cars and trucks and other mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use.
- E. The Contractor shall issue identification badges to all authorized workers.
- F. The site and building are classified as a non-smoking/non-tobacco products area and this policy is to be strictly enforced.
- G. Do not use fire lanes for construction traffic or storage.

1.7 OWNER OCCUPANCY OF SITE AND BUILDING DURING CONSTRUCTION

- A. The building will be occupied during the work. If water service to domestic or sprinkler systems must be turned off, then work requiring the disruption in service shall be performed when the building is unoccupied. Unoccupied times shall be identified by the Owner, and the Contractor shall ensure that complete water service is restored prior to the building becoming occupied again.

- B. All areas of work shall be protected from dust and debris caused by the work. All areas of work shall be completely cleaned at the end of each work day. Protection and cleaning are the sole responsibility of the Contractor. The Contractor shall reimburse the Owner for cleaning, or other labor and materials necessitated by the Contractor's neglect.
- C. The Contractor shall provide insulated, dust-proof temporary barriers as required to minimize impact on the temperature of adjacent spaces and containing all contaminants from the construction.
- D. The building shall be left in a secure, water-tight condition at the end of each work day.
- E. Power shall remain uninterrupted. Any proposed power interruption shall be coordinated with the Clerk-of-the-Works. The Contractor shall give 72 hours advance notice for any power interruption.
- F. Any relocation of low voltage cabling shall be approved and coordinated with Pulaski County Parks and Recreation through the Clerk-of-the-Works not less than one (1) week prior to the work. No I.T. or other low voltage devices shall be disturbed by the work. All low voltage and I.T. components shall be protected throughout the project. Any damaged low voltage and/or I.T. device or component shall be replaced by the Contractor at no additional cost to the Owner, and to the Owner's satisfaction.
- G. Site work shall not interfere with administrative operations and shall not pose a threat to the safety of staff. The Contractor shall provide safety fence as required by the Owner and Authorities Having Jurisdiction to ensure safe separation of work.

1.8 DRESS

- A. Proper dress is necessary for reasons of health and safety and shall meet the requirements established by the Contractors involved. Contractor shall also inform workers to dress in a manner that displays professionalism. Clothing that bears inappropriate or offensive language (at the discretion of the Owner) or slogans is not allowed.

1.9 PRODUCT HANDLING

- A. Product Handling: Space at the project for storage of materials and products is limited. Coordinate the deliveries of materials and products with the scheduling and sequencing of the work so that storage requirements at the project are minimized. In general, do not deliver individual items of equipment and material to the project substantially ahead of the time of installation. Limit each shipment of bulk and multiple-use materials to the quantities needed for installations within three (3) weeks of receipt.

1.10 INTENT OF CONTRACT DOCUMENTS

- A. The contract documents are complementary, and what is called for in one place shall be as binding as if called for in all places. In case of conflict or variance among the contract drawings, the specifications shall take precedence over the drawings. Figured dimensions shall be used in preference to scaling the drawings. In case of conflict between large and small scale plans, the large scale plans shall govern. In case of conflict between riser diagrams and plans, the plans shall govern.
- B. The mechanical and electrical drawings show the general arrangement of all piping, wiring, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The mechanical and electrical work shall conform to the

requirements shown on all of the drawings. General and structural drawings shall take precedence over mechanical and electrical drawings. Because of the small scale of the mechanical and electrical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, boxes, offsets, transitions, and other accessories as may be required to meet such conditions. The Contractor, at his sole expense, shall relocate, or otherwise reconcile, any existing construction that interferes with installation of new work. Refer to Section 011000, Para. 1.7 for requirements of continued use and occupancy.

1.11 CODES AND STANDARDS

- A. All materials and workmanship shall comply with all applicable codes, state and federal laws, local ordinances, industry standards, utility company regulations, and all other criteria which normally apply to work of this nature.
- B. In case of difference between building codes, state laws, federal laws, local ordinances, industry standards, utility company regulations, other criteria and the contract documents, the more stringent regulations will apply. The Contractor shall promptly notify the Architect/Engineer in writing of any such difference.
- C. If the Contractor performs any work that does not comply with these contract documents or the requirements of the applicable building codes, state laws, local ordinances, industry standards, utility company regulations, and other applicable criteria, he shall bear all costs arising in correcting the deficiencies.
- D. The standards referred to, except as modified in the specifications, shall have full force and effect as though printed in these specifications. These standards are not furnished to bidders for the reason that it is assumed that the manufacturer and trades involved are familiar with their requirements. The Architect/Engineer will furnish, upon request, information as to how copies of the standards referred to may be obtained.

1.12 EQUIPMENT DEVIATIONS

- A. Equipment or Connections Different from Those Shown: Where equipment requiring different arrangements or connections from those shown is proposed by the Contractor and is not objected to by the Architect/Engineer, it shall be the responsibility of the Contractor to install the equipment to operate properly and in harmony with the intent of the drawings and specifications. The Contractor shall make all incidental changes in piping, ductwork, supports, insulation, wiring, heaters, controls, and other associated facilities. He shall provide all additional motors, controllers, valves, fittings, and other additional equipment required for proper operation of the system, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing-in and connections. All such changes shall be made at no increase in the contract price to the Owner.
- B. Electric Equipment Ratings: The electrical design is based upon estimated load requirements and upon typical classes of equipment component arrangement. Where the equipment actually provided requires circuits, wiring, controls or protective devices different from those indicated, all required modifications shall be made by the Contractor at no increase in contract price to the Owner.

1.13 BUILDING PERMIT

- A. The General Contractor and his subcontractors shall obtain and pay for all required building permits from Pulaski County, Virginia. All connection fees for water, sewer and permanent electrical power shall be paid for by the Owner. All inspections required by the local jurisdiction shall be scheduled by the Contractor with sufficient lead time. All connection fees and use charges for temporary utilities shall be paid by the Contractor until Substantial Completion of the entire building is achieved. Public Improvement Securities required by localities shall be obtained/paid by the Owner.

1.14 REGISTRATION AND PERFORMANCE AND PAYMENT BONDS

- A. Bidders are required under Title 54.1, Chapter 11, Code of Virginia (1950), as amended, to be licensed as a "Class A Contractor" before submitting a bid of one hundred twenty thousand (\$120,000) dollars or more; or to be licensed as a "Class B Contractor" before submitting a bid of ten thousand (\$10,000) dollars or more but less than one hundred twenty thousand (\$120,000) dollars; or be licensed as a "Class C Contractor" before submitting a bid of no more than ten thousand dollars (\$10,000). Each Bidder will be required to give their State Registration Number on their proposal.
- B. In accordance with Title 2.2, Chapter 43, Part 37 of the code of Virginia, Performance and Payment Bonds shall be provided for construction contracts exceeding \$500,000.00.

1.15 INSPECTION FOR SUBSTANTIAL COMPLETION AND FINAL COMPLETION

- A. The Contractor shall notify the Owner, in writing on the Certificate of Substantial Completion, of the date when the Work or designated portion thereof, will be, in his opinion, substantially complete and ready for inspection and testing to determine if it has reached Substantial Completion. The notice shall be given at least ten days in advance of said date and shall be forwarded through the Architect/Engineer, who will attach his written endorsement as to whether or not he concurs with the Contractor's statement that the Work will be ready for inspection and testing on the date given. The Architect/Engineer's endorsement is a convenience to the Owner only and shall not relieve the Contractor of his responsibility in the matter nor shall the Architect/Engineer's endorsement be deemed to be evidence that the Work was substantially complete and ready for inspection and testing. Inspection and testing shall take place at a time(s) mutually agreeable to the Contractor, Owner and Architect/Engineer. The inspection shall include a demonstration by the Contractor that all equipment, systems and operable components of the project function properly and in accordance with the Contract Documents. The Contractor shall furnish access for the inspection and testing as provided in General Conditions. The inspection and testing shall determine whether Substantial Completion has been accomplished and shall result in a written list of unfinished Work and Defective Work, commonly referred to as a "punch list", which must be finished and corrected to obtain Final Completion. After successful completion of the testing and the Architect/Engineer determines that, in its opinion, the Work, either in whole or in part, is substantially complete, the Architect/Engineer shall notify the Owner, in writing that the Work, or a specified portion thereof, is recommended to be declared substantially complete. The Owner shall notify the Contractor, in writing, of the date the Owner accepts the Work, or the specified portion thereof, as substantially complete or the Owner shall notify the Contractor of the deficiencies to be corrected or completed before such Work will be accepted as substantially complete.
- B. The Contractor shall notify the Owner, in writing of the date when the Work has reached or will reach Final Completion and will be ready for final inspection and testing. The notice shall be given at least five days in advance of said date and shall be forwarded through the Architect/Engineer, who

will attach his endorsement as to whether or not he concurs in the Contractor's statement that the Work will be ready for inspection and testing on the date given. That inspection and any necessary testing shall be conducted in the same manner as the inspection for Substantial Completion. When the Work is finally and totally complete, including the elimination of all defects, the Work shall be finally accepted by the Owner and final payment shall be made in accordance with General Conditions.

- C. The Architect/Engineer shall conduct the inspections. The Owner's Clerk-of-the-Works shall conduct the reinspections. If one or more Substantial or Final Completion reinspections are required, the Contractor shall reimburse the Owner for all costs of reinspection or, at the Owner's option, the costs may be deducted from payments due to the Contractor.

1.16 LIQUIDATED DAMAGES

- A. All work shall be substantially complete by the agreed upon date. For each day after the Contract date of Substantial Completion that the work is not substantially complete, the Contractor shall pay to the Owner as liquidated damages the amount of \$1,000 per day for the Owner's added administrative expense to the Owner to administer the Project during the period of delay. The Owner may deduct any liquidated damages from the money due or to become due to the Contractor. If the amount of liquidated damages exceeds any amounts due to the Contractor, the Contractor shall pay the difference to the Owner within ten (10) days after receipt of a written request from the Owner for payment.
- B. At the time the Architect certifies the Project or parts thereof are substantially completed, the Architect shall identify the remaining items to be completed for final completion of the Project and shall establish with the Contractor a reasonable time for completion of those items. The items to be completed and the time established for their completion shall be set forth in the Certificate of Substantial Completion. The Owner may deduct any liquidated damages from the money due or to become due to the Contractor. If the amount of liquidated damages exceeds any amounts due to the Contractor, the Contractor shall pay the difference to the Owner within ten (10) days after receipt of a written request from the Owner for payment

1.17 PRECONSTRUCTION CONFERENCE

- A. After award of the contract, but before start of construction, the Contractor, Owner, and Architect/Engineer shall meet at the site to discuss procedures to be followed during construction. See Section 013200, CONSTRUCTION PROGRESS DOCUMENTATION.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Selected materials and equipment are specified in the Contract Documents by allowances. In some cases, these allowances include installation.
 - 2. Allowances have been established to defer selection of actual materials and equipment to a later date when additional information is available for evaluation.
 - 3. Reference Paragraph 3.8 of the General Conditions, and modifications in Supplementary Conditions.
 - a. The following is Paragraph 3.8 stated for convenience:

3.8 ALLOWANCES

- 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

- 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
 - .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
 - .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

- 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness."

- 4. Allowance(s) shall be included in Base Bid for the project.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise the Architect/Engineer of the date when the final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

- B. At the Architect/Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by the Architect/Engineer from the designated supplier.

1.4 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show the actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.5 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed for the Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. At Project closeout, credit unused amounts remaining in the contingency allowance to the Owner by Change Order.

1.6 UNUSED MATERIALS

- A. Return unused materials to the manufacturer or supplier for credit to the Owner, after installation has been completed and accepted.
 - 1. When requested by the Architect/Engineer, prepare unused material for storage by Owner where it is not economically practical to return the material for credit. When directed by the Architect/Engineer, deliver unused material to the Owner's storage space. Otherwise, disposal of unused material is the Contractor's responsibility.

1.7 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1 - Provide a general contingency allowance of \$350,000.
- B. Allowance No. 2 - Provide an allowance for specialized golf turf and nets of \$75,000.
- C. Allowance No. 3 - Provide an allowance for drop down batting cages of \$25,000.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.
- B. Provide means to provide and install described work including all labor, materials, equipment, shipment and handling, insurance, operating overhead, and applicable taxes.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Suspended Acoustical Tile Ceiling (SATC)
 - 1. Description: Unit price for increase or decrease in suspended acoustical tile ceiling
 - 2. Unit of Measurement: Square foot.

END OF SECTION

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

1.3 RELATED WORK

- A. In general, the following related work is included in other sections of the specifications:
 - 1. Division 1 Section "Submittal Procedures" specifies requirements for submitting the Contractor's Construction Schedule and the Submittal Schedule.
 - 2. Division 1 Section "Product Requirements" specifies requirements governing the Contractor's selection of products and product options.

1.4 DEFINITIONS

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:
 - 1. Revisions to the Contract Documents requested by the Owner or Architect/Engineer.
 - 2. Specified options of products and construction methods included in the Contract Documents.
 - 3. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.5 SUBMITTALS

- A. Substitution Request Submittal: The Architect/Engineer will consider requests for substitution if received within 60 days after Notice to Proceed with the Work. Requests received more than 60 days after commencement of the Work may be considered or rejected at the discretion of the Architect.
 - 1. Submit three (3) copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for change-order proposals.
 - 2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
 - 3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors, that will be necessary to accommodate the proposed substitution.

- b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
 - c. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - f. Cost information, including a proposal of the net change, if any in the Contract Sum.
 - g. The Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
 - h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
- B. Architect/Engineer's Action: If necessary, the Architect/Engineer will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Architect/Engineer will notify the Contractor of acceptance or rejection of the substitution within two (2) weeks of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance will be in the form of a Construction Change Directive or in the form of shop drawing submittal approval for "or equal" request.
- 1. Use the product specified if the Architect cannot make a decision on the use of a proposed substitute within the time allocated.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Conditions: The Architect/Engineer will receive and consider the Contractor's request for substitution when one or more of the following conditions are satisfied, as determined by the Architect/Engineer. If the following conditions are not satisfied, the Architect/Engineer will return the requests without action except to record noncompliance with these requirements.
- 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents.
 - 3. The request is timely, fully documented, and properly submitted.
 - 4. The specified product or method of construction cannot be provided within the Contract Time. The Architect will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
 - 5. The request is directly related to an "or-equal" clause or similar language in the Contract Documents. The burden of proof of equality rests with the Contractor, who must furnish adequate supporting data.
 - 6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 - 7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.
 - 8. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.

9. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
- B. The Contractor's submittal and the Architect's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with the Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

PART 3 - EXECUTION

Not used.

Attachment: Substitution Request Cover Sheet (After Bid)

END OF SECTION

SUBSTITUTION REQUEST COVER SHEET (AFTER BID)

TO: ZMM ARCHITECTS ENGINEERS
1116 South Main Street
Blacksburg, VA 24060
Fax: (540) 951-0219

This form must be submitted by a Prime Contractor. Submissions by subcontractors, suppliers or product representatives will not be permitted and will be rejected.

PROJECT TITLE:

PRIME CONTRACTOR:

ADDRESS:

AUTHORIZED SIGNATURE:

DATE:

SECTION:

PARAGRAPH:

SPECIFIED ITEM:

PROPOSED SUBSTITUTE:

Substitutions are only permitted by Prime Contractor for one of the following reasons which are outlined in Paragraph 2.1 of Section 012500, SUBSTITUTION PROCEDURES. Substitution requests submitted for reasons other than that listed below will be rejected and returned without action. Indicate below the reason for this proposed substitution request.

_____ The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

_____ The specified product or method of construction cannot receive necessary approval by governing authority, and the requested substitution can be approved.

_____ The request is directly related to an "or equal" clause or similar language in the Contract Documents.

_____ The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.

_____ The specified product or method of construction cannot be coordinated with other materials and

where the Contractor certifies that the proposed substitution can be coordinated.

_____ The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.

Substitution requests must be received by the Architect within 60 days after Notice to Proceed with the Work to be considered.

Substitution requests must include all information indicated in Paragraph 1.5 of Section 012500, SUBSTITUTION PROCEDURES and must meet all requirements stated elsewhere in the Project Manual.

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.
 - 1. All "Requests for Information" (RFI), Proposal Request, and Change Orders (CO) and Cost Proposals (CP) shall be coordinated and routed through the General Contractor.
 - 2. The Contractor shall utilize copies of the "Request for Information" Form attached to the end of this section. The Architect/Engineer will send the response to the General Contractor. No response will be made directly to any subcontractor.
 - 3. The Architect/Engineer will issue all Proposal Requests. Form attached to the end of this section.
 - 4. The Contractor shall use the File Management System prescribed by ZMM ARCHITECTS ENGINEERS to route and receive the documents detailed in this section.

1.3 RELATED WORK

- A. In general, the following related work is included in other sections of the specifications:
 - 1. Division 1 Section "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Division 1 Section "Submittal Procedures" for requirements for the Project Construction Schedule.
 - 3. Division 1 Section "Payment Procedures" for administrative procedures governing Applications for Payment.

1.4 MINOR CHANGES IN THE WORK

- A. The Architect/Engineer will issue a response to Request for Information, an Architect's Supplemental Instruction, or a Proposal Request authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time.

1.5 CHANGES IN THE WORK THAT MAY AFFECT CONTRACT SUM AND/OR CONTRACT TIME

- A. The Architect/Engineer will issue a Proposal Request containing detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued solely by the Architect/Engineer are for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change, unless also signed by the Owner.

2. Within ten (10) business days of receipt of a Proposal Request, the Contractor shall submit a statement of cost necessary to execute the change to the Architect/Engineer for the Owner's review.
 - a. Include a list of quantities of products required and material unit costs, with the total amount of purchases to be made. Include labor quantities and labor unit costs. Where requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time. If no statement is included, it shall be assumed that the work has no effect on Contract Time.
- B. Contractor-Initiated Proposals: When latent or unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a Request for Information with recommendations to the Architect/Engineer, or a Cost Proposal (CP) with detail of cost as if it were a Proposal Request.
 1. Contractor shall include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
 2. The Architect/Engineer will respond to the RFI and then issue a Proposal Request as indicated above if required.
 3. Contractor shall reimburse the Owner through the Contract for Construction for any expenses related to the Architect's services resulting from changes requested by the Contractor if for the benefit of the Contractor.
- C. Proposal Request and Contractor initiated Cost Proposals will be included in Change Orders prior to project closeout.

1.6 ALLOWANCES

- A. Allowance Adjustment: For allowance-cost adjustment, the Architect/Engineer shall base each Change Order on the difference between the actual purchase amount and the allowance, multiplied by the final measurement of work-in-place. Where applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 1. Include installation costs in the purchase amount only where indicated as part of the allowance.
 2. When requested, prepare explanations and documentation to substantiate the margins claimed.
 3. The Owner reserves the right to establish the actual quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or the Contractor's handling, labor, installation, overhead, and profit. Submit claims within ten (10) business days of receipt of the Change Order or Proposal Request authorizing work to proceed. Claims submitted later than ten (10) business days shall be considered null and void.

1.7 CHANGE ORDER PROCEDURES

- A. Change Orders will be executed as follows:
 - 1. At the end of the project to establish final adjustments to Contract Sum and Contract Time, based on Proposal Request approved throughout the project, should a Contingency Allowance or other allowances, exist as part of the Contract amount and has not been exceeded by approved Proposal Request costs.
 - 2. When no Contingency Allowance, or other allowances, exists as part of the Contract amount, Change Orders will be used to order changes in the work that may affect Contract Sum and/or Contract Time.
 - 3. A Change Order may be used to approve the terms of a Contractor initiated Cost Proposal, should the Architect not choose to issue a corresponding Proposal Request.

1.8 REQUESTS FOR INFORMATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Progress meeting, prepare and submit an RFI in the form specified.
 - 1. RFIs shall originate with General Contractor. RFIs submitted by entities other than General Contractor will be returned with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
 - 3. Frivolous or unnecessary RFIs will be returned with no response.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Contractor.
 - 4. Name of Architect.
 - 5. RFI number, numbered sequentially.
 - 6. Specification Section number and title and related paragraphs, as appropriate.
 - 7. Drawing number and detail references, as appropriate.
 - 8. Field dimensions and conditions, as appropriate.
 - 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 10. Contractor's signature.
 - 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
 - 12. Date by which a response from the Architect/Engineer is needed to avoid affecting critical path tasks.
- C. Hard-Copy RFIs: Form at the end of this Section.
 - 1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
 - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.

- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Change Order Proposal Request as contained within this section.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within ten (10) business days of receipt of the RFI response. Requests for time extensions related to RFI responses that are received after ten (10) business days shall be considered null and void.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within two (2) business days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Architect's Supplemental Instructions, Proposal Request, Change Order or Contractor initiated Cost Proposal, as appropriate.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION



AIA® Document G714® – 2017

Construction Change Directive

PROJECT: *(name and address)*

Jefferson County Schools
Secure Entrances
Jefferson County, WV
A/E Project #2024-045

CONTRACT INFORMATION:

Contract For: General Construction
Date:

CCD INFORMATION:

Directive Number:
Date:

OWNER: *(name and address)*

Jefferson County Board of Education

110 Mordington Avenue
Charles Town, WV 25414

ARCHITECT: *(name and address)*

ZMM, Inc. (dba ZMM Architects and
Engineers)
1116 South Main Street
Blacksburg, VA 24060

CONTRACTOR: *(name and address)*

The Contractor is hereby directed to make the following change(s) in this Contract:
(Insert a detailed description of the change and, if applicable, attach or reference specific exhibits.)

PROPOSED ADJUSTMENTS

1. The proposed basis of adjustment to the Contract Sum or Guaranteed Maximum Price is:

☒ Lump Sum decrease of \$0.00

☐ Unit Price of \$ per

☐ Cost, as defined below, plus the following fee:
(Insert a definition of, or method for determining, cost)

☐ As follows:

2. The Contract Time is proposed to . The proposed adjustment, if any, is .

NOTE: The Owner, Architect and Contractor should execute a Change Order to supersede this Construction Change Directive to the extent they agree upon adjustments to the Contract Sum, Contract Time, or Guaranteed Maximum price for the change(s) described herein.

When signed by the Owner and Architect and received by the Contractor, this document becomes effective IMMEDIATELY as a Construction Change Directive (CCD), and the Contractor shall proceed with the change(s) described above.

Contractor signature indicates agreement with the proposed adjustments in Contract Sum and Contract Time set forth in this CCD.

ARCHITECT *(Firm name)*

OWNER *(Firm name)*

CONTRACTOR *(Firm name)*

SIGNATURE

Randy S. Jones, AIA Principal

PRINTED NAME AND TITLE

SIGNATURE

Dr. Chuck Bishop,
Superintendent

PRINTED NAME AND TITLE

SIGNATURE

PRINTED NAME AND TITLE

DATE

DATE

DATE



AIA[®] Document G716[™] – 2004

Request for Information (“RFI”)

TO:

FROM:

PROJECT:

Jefferson County Schools
Secure Entrances
Jefferson County, WV

ISSUE DATE:

RFI No.

PROJECT NUMBERS: 2024 / 045

REQUESTED REPLY DATE:
COPIES TO:

RFI DESCRIPTION: *(Fully describe the question or type of information requested.)*

REFERENCES/ATTACHMENTS: *(List specific documents researched when seeking the information requested.)*
SPECIFICATIONS: **DRAWINGS:** **OTHER:**

SENDER'S RECOMMENDATION: *(If RFI concerns a site or construction condition, the sender may provide a recommended solution, including cost and/or schedule considerations.)*

RECEIVER'S REPLY: *(Provide answer to RFI, including cost and/or schedule considerations.)*

BY

DATE

COPIES TO

Note: This reply is not an authorization to proceed with work involving additional cost, time or both. If any reply requires a change to the Contract Documents, a Change Order, Construction Change Directive or a Minor Change in the work must be executed in accordance with the Contract Documents.

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

1.3 SUBMITTALS

- A. Schedule of Values:
 - 1. Within 15 calendar days of receipt of a notice of award, prepare and deliver to ZMM ARCHITECTS ENGINEERS a schedule of values. The schedule of values shall consist of a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices therefor. The detailed breakdown shall be divided into each construction category. The required schedule shall be based on the actual breakdown of the bid price. Subcontractors who may be involved in work under more than one of these categories shall be advised of this requirement in order to furnish such data without delay. The schedule of values shall list material and labor separately.
 - 2. Payments will not be made until the schedule of values has been submitted to and approved by ZMM ARCHITECTS ENGINEERS.

1.4 APPLICATION FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect/Engineer and paid for by the Owner.
 - 1. The initial Application for Payment, the Application for Payment at the time of Substantial Completion, and the final Application for Payment involve additional requirements.
- B. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction Work covered by each Application or Payment is the period indicated in the Agreement.
- C. Payment Application Forms: Use AIA Document G702 as the form for Application for Payment.
- D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents. Incomplete applications will be returned without action.
 - 1. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the Application.
- E. Draft for Review: At least 3 days prior to transmittal of formal application, the Contractor shall email a draft copy of the application to the Architect and Clerk of the Works for review and comment.
- F. Transmittal: Submit 3 executed copies of each formal Application for Payment to the Architect/Engineer by means ensuring receipt within 24 hours; one copy shall be complete, including

waivers of lien and similar attachments, when required. The comments of the Owner and Architect following their review of the draft application shall be addressed in the formal Application.

- G. Formal pay applications shall be delivered to the Architect at the jobsite Progress Meeting prior to application due date, unless otherwise agreed upon by Owner and Architect.
- H. Initial Application for Payment: Administrative actions, submittals, and approvals that must precede or coincide with submittal of the first Application for Payment include the following:
 - 1. Schedule of Values submitted and approved by Architect.
 - 2. Contractor's construction schedule.
 - 3. Copies of building permits.
 - 4. Copies of authorizations and licenses from governing authorities for performance of the Work.
 - 5. Certificates of insurance and insurance policies.
 - 6. Performance and payment bonds.
 - 7. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
 - 1. Administrative actions and submittals that shall precede or coincide with this application include:
 - a. Occupancy permits and similar approvals.
 - b. Warranties (guarantees) and maintenance agreements.
 - c. Maintenance instructions.
 - d. Meter readings.
 - e. Changeover information related to Owner's occupancy, use, operation, and maintenance.
 - f. Final cleaning.
 - g. Application for reduction of retainage and consent of surety.
 - h. Advice on shifting insurance coverages.
 - i. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.
- J. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:
 - 1. Completion of Project closeout requirements.
 - 2. Completion of items specified for completion after Substantial Completion.
 - 3. Assurance that unsettled claims will be settled.
 - 4. Assurance that Work not complete and accepted will be completed without undue delay.
 - 5. Transmittal of requirement Project construction records to Owner.
 - 6. Proof that taxes, fees and similar obligations have been paid.
 - 7. Removal of temporary facilities and services.
 - 8. Removal of surplus materials, rubbish and similar elements.
- K. Waivers of Mechanics Liens: With Final Application for Payment, submit waivers of mechanics lien from every entity who may lawfully be entitled to file a mechanics lien arising out of the Contract, and related to the Work covered by the payment. The following shall be submitted:
 - 1. Contractor's Affidavit of Payment of Debts and Claims (AIA G706).
 - 2. Contractor's Affidavit of Release of Liens (AIA G706A).
 - 3. Consent of Surety to Final Payment (AIA G707).

PCPR – Facility Renovation Indoor Sportsplex and Expo Center

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 013100 - COORDINATION

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
 - 1. General project coordination procedures.
 - 2. Conservation.
 - 3. Coordination drawings.
 - 4. Administrative and supervisory personnel.
 - 5. Cleaning and protection.

1.3 RELATED WORK

- A. In general, the following related work is included in other sections of the specifications:
 - 1. Division 1 Section "Construction Progress Documentation" for preconstruction conference and progress meetings.
 - 2. Division 1 Section "Submittal Procedures" for preparing and submitting the Contractor's Construction Schedule.
 - 3. Division 1 Section "Product Requirements" for coordinating general installation.
 - 4. Division 1 Section "Closeout Procedures" for coordinating contract closeout.

1.4 COORDINATION

- A. Coordinate construction operations included in various Sections of these Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation. No claim for extra compensation or extension of contract time will be allowed for conditions resulting from lack of said coordination.
 - 1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Consider restrictions on use of the building and Owner's occupancy during construction.
 - 5. The Contractor shall use the File Management System prescribed by ZMM ARCHITECTS ENGINEERS to route and receive the documents detailed in this section.
- B. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface requirements has been checked and satisfactorily established.

- C. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
 - 1. Prepare similar memoranda for the Owner and separate contractors where coordination of their work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of construction schedules.
 - 2. Preparation of the Schedule of Values.
 - 3. Installation and removal of temporary facilities.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Project closeout activities.
 - 7. Utility company's coordination.
- E. Conservation: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work.

1.5 SUBMITTALS

- A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components. Preparation of Coordination Drawings is the responsibility of the Contractor.
 - 1. Show the relationship of components shown on separate Shop Drawings.
 - 2. Indicate required installation sequences.
 - 3. For locations where several elements of mechanical or electrical, or combined mechanical and electrical, work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination drawings to a scale of 1/4"-1'-0" or larger showing the actual physical dimensions required for the installation.
 - 4. Prepare and submit coordination drawings prior to purchase-fabrication-installation of any of the elements involved in the coordination.
 - 5. Comply with requirements contained in Section "Submittal Procedures."
- B. Discrepancies in Contract Drawings: The Contractor shall promptly notify the Architect/Engineer of all errors, omissions, or discrepancies which he finds on the drawings. The Contractor shall not proceed with the work involved in such errors, omissions, or discrepancies until written instructions are given by the Architect/Engineer. The Contractor shall be responsible for all work erroneously installed prior to receiving said written instructions.
- C. Staff Names: Within 15 days of commencement of construction operations, submit a list of the Contractor's principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.

1. Post copies of the list in the Project meeting room, the temporary field office, and each temporary telephone.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.
- C. Test and Inspections: As part of the coordination requirements, the Contractor shall have a representative of his at all tests and inspections required, including those performed by subcontractors. The Contractor shall be responsible for ensuring that all tests and inspections are conducted as required and that the work is acceptable. The Contractor shall immediately inform the Architect/Engineer of all tests and inspections that fail to meet specification requirements. The Contractor shall immediately do everything within his power; including stopping work in progress, to make sure work that does not meet specifications does not get permanently installed or covered up.

3.2 CLEANING AND PROTECTION

- A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.
- B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.
- C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 1. Excessive static or dynamic loading.
 2. Excessive internal or external pressures.
 3. Excessively high or low temperatures.
 4. Thermal shock.
 5. Excessively high or low humidity.
 6. Air contamination or pollution.
 7. Water or ice.
 8. Solvents.
 9. Chemicals.

10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining, and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High-speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.
31. Dust and dirt on and in mechanical equipment and ductwork.

END OF SECTION

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings including, but not limited to:
 - 1. Preconstruction Conference.
 - 2. Preinstallation Conference.
 - 3. Progress Meetings.
- B. All conferences shall follow COVID-19 safety guidelines as issued by the Governor of Virginia and/or Pulaski County Virginia.

1.3 PRECONSTRUCTION CONFERENCE

- A. The Architect/Engineer shall schedule a Preconstruction Conference and organizational meeting to be held at the project site or other convenient location no later than 15 days after execution of the Agreement and prior to commencement of construction activities. The Architect/Engineer shall conduct the meeting to review responsibilities and personnel assignments.
- B. Attendees: The following parties shall be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.
 - 1. Owner.
 - 2. Clerk-of-the-Works.
 - 3. Architect/Engineer.
 - 4. Contractor.
 - a. Project Manager.
 - b. Superintendent.
 - 5. Major subcontractors.
 - 6. Inspection and testing agencies.
- C. Agenda: Discuss items of significance that could affect progress including such topics as:
 - 1. Designation of responsible personnel.
 - 2. Tentative construction schedule.
 - 3. Critical work sequencing.
 - 4. Use of the premises.
 - 5. Parking availability.
 - 6. Office, work and storage areas, equipment deliveries and priorities.
 - 7. Safety procedures.
 - 8. First aid.
 - 9. OSHA.
 - 10. Security.

11. Housekeeping.
12. Working hours.
13. Distribution of Contract Documents.
14. Relation and coordination of major subcontractors.
15. Procedures for processing field decisions and Change Orders.
16. Procedures for processing Applications for Payment.
17. Submittals of shop drawings, product data, and samples.
18. Preparation of record documents.

1.4 PREINSTALLATION CONFERENCE

- A. Prior to installation of building components, the General Contractor shall coordinate with the Architect/Engineer to schedule a Preinstallation Conference to be held at the project site or other mutually agreed location with the installing subcontractor, General Contractor, Architect/Engineer, Owner representative and any other affected subcontractor. See **individual specification sections** for preinstallation conference requirements.
- B. The subcontractor must be prepared to outline the procedures to be followed and how they affect other subcontractors.
- C. All parties shall review the progress of other construction activities and preparations for the particular activity under consideration at each Preinstallation Conference, including requirements for the following:
 1. Contract Documents.
 2. Options.
 3. Purchases.
 4. Deliveries.
 5. Shop Drawings, Product Data, and quality-control samples.
 6. Review of mockups.
 7. Possible conflicts.
 8. Compatibility problems.
 9. Time schedules.
 10. Weather limitations.
 11. Manufacturer's recommendations.
 12. Warranty requirements.
 13. Compatibility of materials.
 14. Acceptability of substrates.
 15. Temporary facilities.
 16. Space and access limitations.
 17. Governing regulations.
 18. Safety.
 19. Inspecting and testing requirements.
 20. Required performance results.
 21. Recording requirements.
 22. Protection.
- D. General Contractor shall record significant discussions and agreements and disagreements of each conference, and the approved schedule. General Contractor shall promptly distribute the record of the meeting to everyone concerned, including the Architect/Engineer, Subcontractor, and the Owner.

- E. Do not proceed with the installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.5 PROGRESS MEETINGS

- A. Architect/Engineer or their representative shall conduct progress meetings at the project site at regularly scheduled intervals. Notify the General Contractor and Owner of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.
- B. Attendees: In addition to representatives of the Owner, General Contractor and Architect/Engineer, it is mandatory that each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities be represented at these meetings by persons familiar with the project and authorized to conclude matters relating to progress. Failure to attend may be reason for withholding of progress payment to Contractor.
- C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the project.
 - 1. Contractor's Construction Schedule: An updated Construction Schedule is required at each meeting and not less than twice monthly. Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 2. Review the following with each entity present. Provide color copies of schedule to all those in attendance.
 - a. Note field observations, problems and decisions.
 - b. Identify problems which impede planned progress.
 - c. Review off-site fabrication problems.
 - d. Develop corrective measures and procedures to regain planned schedule.
 - e. Revise Contractor's Construction Schedule as indicated.
 - f. Plan progress during next work period.
 - g. Coordinate projected progress with subcontractors.
 - h. Review submittal schedules, expedite as required to maintain schedule.
 - i. Review maintaining of quality and work standards.
 - j. Review changes proposed for:
 - 1) Effect on Contractor's Construction Schedule.
 - 2) Effect on Completion Date.
 - k. Complete other current business.
 - 3. Contractor shall submit the following:
 - a. Updated submittal log to insure that every item and shop drawing, that is indicated to be submitted, has been submitted.
 - b. Updated equipment list indicating approval status, projected fabrication and delivery dates of major equipment, thus insuring delivery on time.
 - c. Updated Construction Schedule.
- D. Reporting: No later than three (3) days after each progress meeting date, Architect/Engineer shall distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report. If, within two (2) business days of the distribution of the meeting minutes, requests for

corrections are received by the Architect/Engineer from anyone in attendance, the Architect/Engineer shall, if in agreement with the requested changes, edit the meeting minutes and redistribute the edited version. Any requests for revisions received after two (2) business days of initial distribution shall be considered null and void.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in web-based Project management software site:
 - a. Name of Project.
 - b. Date photograph was taken.
 - c. Unique sequential identifier keyed to accompanying key plan.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Metadata: Record accurate date and time from camera.

- C. File Names: Name media files with date Project area and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Construction Manager.
 - 1. Flag excavation areas construction limits before taking construction photographs.
 - 2. Take photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.
 - 4. Electrical conduit.
 - 5. Waterproofing and weather-resistant barriers.
- D. Periodic Construction Photographs: Take photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Additional Photographs: Architect or Construction Manager may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Immediate follow-up when on-site events result in construction damage or losses.
 - b. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - c. Substantial Completion of a major phase or component of the Work.
 - d. Owner's request for special publicity photographs.

PCPR – Facility Renovation Indoor Sportsplex and Expo Center

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This section specifies administrative and procedural requirements for submittals required for performance of the work, including:
 - 1. Submittal procedures.
 - 2. Contractor's construction schedule.
 - 3. Daily construction reports.
 - 4. Submittal cover sheet for shop drawings, product data and samples.
 - 5. Shop drawings.
 - 6. Product data.
 - 7. Samples.
- B. Administrative Submittals: Refer to other Division 1 sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
 - 1. Permits.
 - 2. Applications for Payment.
 - 3. Performance and Payment Bonds.
 - 4. Insurance Certificates.
 - 5. List of Subcontractors.
- C. The Schedule of Values submittal is included in section "Payment Procedures."
- D. Inspection and test reports are included in section "Quality Requirements."

1.3 SUBMITTAL PROCEDURES

- A. Submittal: Unless otherwise specified, electronic shop drawing submittals are preferred, but if hard copies are submitted, the number of shop drawings, product data, and the number of samples which the Contractor shall submit and, if necessary, resubmit, is the number that the Contractor requires to be retained, plus **one** which will be retained by the Architect/Engineer, plus **two** that will be retained by the Owner.
 - 1. The Contractor may make comments on shop drawings during their review in some color other than red. The Architect/Engineer will make all comments in **red only**. (This will identify which party has made the comments.)
- B. If the number of resubmittals of shop drawings exceeds two, the Owner shall charge the Contractor a resubmittal review fee in the amount of \$100 per resubmittal, which is then added to the Architects fee. No time extensions shall be granted for processing and review of Shop Drawings submitted more than two times.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

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 elements of the work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
 - a. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Architect/Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
 - b. If an intermediate submittal is necessary, process the same as the initial submittal.
 - c. Allow two weeks for reprocessing each submittal.
 - d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect/Engineer sufficiently in advance of the work to permit processing.
 - e. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
 - 1) Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
 - 2) Include the following information on the label for processing and recording action taken.
 - Project name.
 - Date.
 - Name and address of Architect/Engineer.
 - Name and address of Contractor.
 - Name and address of Subcontractor.
 - Name and address of supplier.
 - Name of manufacturer.
 - Number and title of appropriate Specification Section.
 - Drawing number and detail references, as appropriate.
 - f. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect/Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
 - 1) On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

1.4 SHOP DRAWINGS, PRODUCT DATA AND SAMPLE SUBMITTALS

A. Contractor Responsibilities:

1. Contractor shall carefully review all submittals upon receipt. By approving and forwarding submittal, Contractor represents that he has verified all governing field measurements and field construction criteria and that he has confirmed that all catalog numbers and similar data comply with Contract Document requirements.

2. Coordinate each submittal with requirements of Work and of Contract Documents.
3. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect/Engineer approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and the Architect has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect/Engineer's approval thereof.
4. Begin no work which requires submittals until return of submittals with Architect/Engineers' stamp and initials or signature indicating approval.

B. Architect/Engineer's Duties:

1. Review submittals with reasonable promptness.
2. Maintain logs of all submittals.
3. Review for general agreement with:
 - a. Design concept of project.
 - b. Information given in Contract Documents.
4. Affix stamp and initials or signature certifying to review of submittals.
5. Review of separate item does not constitute review of an assembly in which that item functions.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule for the benefit of all parties involved. Submit within 15 business days of the date established for "Commencement of Work".

1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the work as indicated in the "Schedule of Values".
2. Within each time bar, indicate completion percentage in 10 percent increments. As work progresses, place a contrasting mark in each bar to indicate Actual Completion.
3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
4. Secure time commitments for performing critical elements of the work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the work.
5. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect/Engineer's procedures necessary for certification of Substantial Completion.

B. Distribution: Following response to the initial submittal, print and distribute copies to the Architect/Engineer, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the work and are no longer involved in construction activities.

- C. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule at each bi-weekly progress meeting, or otherwise, not less than twice monthly.

1.6 DAILY CONSTRUCTION REPORTS

- A. Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Architect/Engineer and the Clerk-of-the-Works at weekly intervals.
 - 1. Person completing the report.
 - 2. List of subcontractors at the site.
 - 3. Approximate count of personnel at the site.
 - 4. High and low temperatures, general weather conditions.
 - 5. Accidents and unusual events.
 - 6. Meetings and significant decisions.
 - 7. Stoppages, delays, shortages, losses.
 - 8. Emergency procedures.
 - 9. Orders and request of governing authorities.
 - 10. Change orders received, implemented.
 - 11. Services connected, disconnected.
 - 12. Equipment or system tests and start-ups.
 - 13. Partial completions, occupancies.
 - 14. Substantial completions authorized.

1.7 SUBMITTAL COVER SHEET

- A. The Contractor shall utilize the attached Submittal Cover Sheet for all items requiring a shop drawing, product data or samples. **If Submittal Cover Sheet is not attached, submitted material will not be reviewed and will be returned to the Contractor.** Include all submittal reviews on Construction Schedule. Anticipate two reviews of shop drawings.

1.8 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Drawings or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.
- B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information.

Dimensions.

Identification of products and materials included.

Compliance with specified standards.

Notation of coordination requirements.

Notation of dimensions established by field measurement.

Certification that all materials are asbestos-free.

- 1. Do not use shop drawings without an appropriate final stamp indicating action taken in connection with construction.

2. Within thirty (30) calendar days after award of Contract, Contractor shall submit to Architect/Engineer a complete submission of all products for which colors are to be selected. Submission shall include a list of products indicating manufacturer's name, model number or name, brochures, color selections, physical samples, and all pertinent data.
 3. In order for the Architect/Engineer to prepare a color board, the selection of colors for approved shop drawings will be withheld until color samples on all building products have been submitted. No individual color selection(s) will be made until complete submission of all project color samples are received.
- C. Coordination drawings are a special type of shop drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.
1. Submit coordination drawings for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space.

1.9 PRODUCT DATA

- A. Collect product data into a single submittal for each element of construction or system. Product data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where product data must be specifically prepared because standard printed data is not suitable for use, submit as "Shop Drawings".
1. Mark each copy to show applicable choices and options. Where printed product data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
 - Manufacturer's printed recommendations.
 - Compliance with recognized trade association standards.
 - Compliance with recognized testing agency standards.
 - Application of testing agency labels and seals.
 - Notation of dimensions verified by field measurement.
 - Notation of coordination requirements.
 2. Do not submit product data until compliance with requirements of the Contract Documents has been confirmed.
- B. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
1. Do not proceed with installation until an applicable copy of product data is in the installer's possession.
 2. Do not permit use of unmarked copies of product data in connection with construction.

1.10 SAMPLES

- A. Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.
1. Mount, display, or package samples in the manner specified to facilitate review of qualities indicated. Prepare samples to match Architect/Engineer's sample. Include the following:

Generic description of the sample.
Sample source.
Product name or name of manufacturer.
Compliance with recognized standards.
Availability and delivery time.

- B. Submit samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - 1. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.
- C. Preliminary Submittals: Where samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
 - 1. Preliminary submittals will be reviewed and returned with the Architect/Engineer's action indicated.
- D. Maintain sets of samples, as returned, at the Project site, for quality comparisons throughout the course of construction.
 - 1. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 - 2. Sample sets may be used to obtain final acceptance of the construction associated with each set.
- E. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the work. Show distribution on transmittal forms.
 - 1. Field samples specified in individual Sections are special types of samples. Field samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the work will be judged.
 - a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.11 ARCHITECT/ENGINEER'S ACTION

- A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect/Engineer will review each submittal, mark to indicate action taken, and return promptly.
- B. Compliance with specified characteristics is the Contractor's responsibility.
- C. Action Stamp: The Architect/Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked to indicate the action taken.
 - 1. Do not permit submittals marked "Not Approved, Revise and Resubmit" to be used at the Project site, or elsewhere where work is in progress.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SUBMITTAL COVER SHEET
(Attach to each copy of each submittal.)

PROJECT: _____

ARCHITECT/ENGINEER: **ZMM, Inc.**
1116 South Main Street
Blacksburg, VA 24060

A/E COMMISSION: _____

PRIME CONTRACTOR: _____

SUBCON./SUPPLIER: _____

MANUFACTURER: _____

ITEM SUBMITTED: _____ **SUBMITTAL #:** _____

SPEC. SECTION #: _____ **PARAGRAPH #:** _____

DRAWING REFERENCE: _____ **DETAIL #:** _____

CERTIFICATION: (Circle one.)

- A. Certified to comply with Drawings and Specifications.
- B. Certified to comply with Drawings and Specifications except as noted on attached Submittal Deviation Sheet.

Signature: Subcontractor/Supplier Date

Signature: Prime Contractor Date

<div style="border: 1px solid black; height: 150px; margin-bottom: 10px;"></div>	<input type="checkbox"/> APPROVED	<input type="checkbox"/> APPROVED AS NOTED
	<input type="checkbox"/> DISAPPROVED	<input type="checkbox"/> REVISE AND RESUBMIT
	<input type="checkbox"/> RECEIPT ACKNOWLEDGED	
	<div style="border: 1px solid black; padding: 5px; font-size: 0.8em;">COMMENTS MADE ON THE SHOP DRAWINGS DURING THIS REVIEW DO NOT RELIEVE THE CONTRACTOR FROM COMPLIANCE WITH REQUIREMENTS OF THE DRAWINGS AND SPECIFICATIONS. THIS CHECK IS ONLY FOR REVIEW OF GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. THE CONTRACTOR IS RESPONSIBLE FOR: CONFIRMING AND CORRELATING QUANTITIES AND DIMENSIONS, SELECTING FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION, COORDINATING THIS WORK WITH THAT OF ALL OTHER TRADES, AND PERFORMING WORK IN A SAFE AND SATISFACTORY MANNER. NOTE ANY DEVIATIONS IN ATTACHED SUBMITTAL DEVIATION SHEET.</div>	
<div style="border: 1px solid black; padding: 5px; font-size: 0.8em;">DATE: _____ BY: _____ ZMM, Inc.</div>		

(PRIME CONTRACTOR APPROVAL STAMP)

(ARCHITECT/ENGINEER REVIEW STAMP)

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This section specifies administrative and procedural requirements for quality control services.
- B. Quality control services include inspections, tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect/Engineer and Clerk-of-the-Works.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality control requirements for individual construction activities are specified in the sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
 - 2. Inspections, tests and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for the Contractor to provide quality control services required by the Architect/Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this section.

1.3 THREE PHASES OF CONTROL

- A. The Contractor shall actively perform overall quality control of all work under the Contract. The Contractor shall perform three phases of control to ensure that all work complies with Contract requirements. The Three Phases of Control shall adequately cover all work and shall include the following for each definable feature of work: A definable feature of work is a task which is separate and distinct from other tasks and requires separate control requirements.
 - 1. Preparatory Phase: Notify the Clerk-of-the-Works at least 2 work days in advance of each preparatory phase. The superintendent shall conduct the preparatory phase with the Clerk-of-the-Works and the foreman responsible for the definable feature. Document the results of the preparatory phase actions in the Daily Construction Report. Perform the following prior to beginning work on each definable feature of work:
 - a. Review each paragraph of the applicable specification sections;
 - b. Review the Contract drawings;
 - c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;

- d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;
 - e. Examine the work area to ensure that the required preliminary work has been completed;
 - f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;
 - g. Review the safety plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted; and
 - h. Discuss construction methods.
 2. Initial Phase: Notify the Clerk-of-the-Works at least 2 work days in advance of each initial phase. When construction crews are ready to start work on a definable feature of work, the superintendent shall conduct the initial phase with the Clerk-of-the-Works and the foreman responsible for that definable feature of work. Observe the initial segment of the definable feature of work to ensure that the work complies with Contract requirements. Any work not in conformance with specifications shall be stopped immediately by the Contractor and corrective measures taken. Document the results of the initial phase in the Daily Construction Report. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each definable feature of work:
 - a. Establish the quality of workmanship required;
 - b. Resolve conflicts;
 - c. Review the Safety Plan and the appropriate activity hazard analysis to ensure that applicable safety requirements are met; and
 - d. Ensure that testing is performed by the approved laboratory.
 3. Follow-Up Phase: Perform the following for on-going work daily, or more frequently as necessary until the completion of each definable feature of work and document in the Daily Construction Report:
 - a. Ensure the work is in compliance with Contract requirements;
 - b. Maintain the quality of workmanship required;
 - c. Ensure that testing is performed by the approved laboratory;
 - d. Ensure that rework items are being corrected; and
 - e. The superintendent shall maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Contractor Rework Items List" to the last Daily Construction Report of each month. The Contractor shall be responsible for including on this list items needing rework including those identified by the Clerk-of-the-Works.

1.4 RESPONSIBILITIES

- A. Contractor Responsibilities: The Contractor shall provide inspections, tests and similar quality control services, specified in individual specification sections and required by governing authorities, except where they are specifically indicated to be the Owner's responsibility, or are provided by another identified entity; these services include those specified to be performed by an independent agency and not by the Contractor. Costs for these services shall be included in the Contract Sum.
 1. The Contractor shall employ and pay an independent agency to perform specified quality control services.
 2. It is the responsibility of the Contractor to coordinate inspections with the independent agency. The Contractor shall bear any cost incurred due to a lack of coordination, i.e., independent agency personnel present on site while no activity requiring testing is occurring.

- B. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.
 - 1. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.
- C. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to:
 - 1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
 - 2. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
 - 3. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
 - 4. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 - 5. Security and protection of samples and test equipment at the Project site.
- D. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual specification sections shall cooperate with the Architect/Engineer and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.
 - 1. The agency shall notify the Architect/Engineer and Contractor promptly of irregularities or deficiencies in the Work during performance of its service.
 - 2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
 - 3. The agency shall not perform any duties of the Contractor.

1.5 OBLIGATIONS

- A. All of the Contractor's quality control inspection services and the inspectors shall be unbiased and directly responsive to the Owner and the Architect/Engineer. Written Inspection Reports on completed inspections AND inspections in progress shall be completed each day and at the end of the inspection and copies given first to the Owner and Architect/Engineer and then to the Contractor. The Owner and Architect/Engineer shall have the right to ask the Contractor's inspectors questions at any time. The Contractor's inspectors shall answer all questions and concerns of the Owner and Architect/Engineer directly, professionally, honestly, completely and immediately, without interference from or permission from the Contractor or any of his subcontractors, suppliers, or agents. All costs for inspection services shall be shown separately on the schedule of prices, and payments will only be authorized by the Architect/Engineer and Owner for inspection services that have been provided as detailed in this paragraph. If the Contractor fails to allow the reporting of any inspections as described in this paragraph, the retention percentage on all work will be immediately increased to 10% and remain at that level until such time that the questioned work is retested, and reported to the Architect/Engineer and Owner to be at the specified quality. If work is done without the inspectors present, the retention percentage on all work will be immediately increased to 10% and remain at that level until such time that the work is redone with the inspector present, to the specified quality.

- B. AT least twice per month, at the site, the inspectors must review all of their inspections thus far with the Owner and the Architect/Engineer.
- C. All inspectors and testers must be currently certified in the applicable field of inspections that they are performing; e.g., soils for soils inspection, concrete for concrete inspection, etc. All inspectors and testers must have at least 5 years experience in inspecting their respective area of responsibility.

1.6 SUBMITTALS

- A. The independent testing agency shall submit a certified written report of each inspection, test or similar service, to the Architect/Engineer, in duplicate, unless the Contractor is responsible for the service. If the Contractor is responsible for the service, submit a certified written report of each inspection, test, or similar service through the Contractor, in duplicate. The Architect/Engineer will provide reporting forms and logs to the independent testing agency.
 - 1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
 - 2. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:
 - Date of issue.
 - Project title and number.
 - Name, address and telephone number of testing agency.
 - Dates and locations of samples and tests or inspections.
 - Names of individuals making the inspection or test.
 - Designation of the Work and test method.
 - Identification of the product and Specification Section.
 - Complete inspection or test data.
 - Test results and an interpretations of test results.
 - Ambient conditions at the time of sample-taking and testing.
 - Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements.
 - Name and signature of laboratory inspector.
 - Recommendations on retesting.
- B. The independent testing agency shall maintain a running Deficiencies Log to track each deficiency discovered during all on-site inspections, testing performed in the laboratory, or any other such deficiency occurring within an area of the work which the independent testing agency has been contracted to inspect.
 - 1. The deficiency log shall be a continuous running log of all deficiencies noted during inspections and shall include, at a minimum, the following pieces of information for each deficient item:
 - a. Item number.
 - b. Date the item was originally discovered.
 - c. Location (floor, column grid, etc.).
 - d. Description - A written description of the deficiency.
 - e. Reference - A reference to the specification section, drawing sheet number, shop drawing sheet number, etc. indicating the contract provision to which the item does not comply.
 - f. Status - indicate either "Open" or "Resolved".
 - g. Date Corrected - The date upon which the deficiency was brought into compliance with the contract documents.

- h. Comments - Any pertinent information on the deficiency. Once resolved, this item should indicate the justification for resolution of the item such as "Accepted by Engineer of Record in RFI ????" or "Retesting indicated compaction within acceptable limits", etc.
- 2. Prior to project closeout, each item on the deficiency list shall be resolved to the satisfaction of the Architect/Engineer.
- 3. Deficiency logs shall be updated and submitted weekly.
- 4. The deficiency log to be used for this project is included at the end of this Section of the Specifications. If the independent testing agency has its own deficiency log developed, said log may be used to document deficiencies if first approved by the Architect/Engineer.

1.7 QUALITY ASSURANCE

- A. Qualification for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
 - 1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.
 - 2. Qualifications of inspectors on site shall include 5 years inspection in type of work, and certified for the type of work performed.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, and sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.
- B. Protect construction exposed by or for quality control service activities, and protect repaired construction.
- C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION



DEFICIENCY LOG

Date: _____

Project No. _____

Project: _____

INDEPENDENT TESTING AGENCY: _____

No.	Date	Location	Description	Status	Reference	Date Corrected	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Date: _____ Project No. _____ Project: _____

[illegible]

SECTION 014500 – STRUCTURAL TESTING, INSPECTION, AND QUALITY ASSURANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Inspection and testing laboratory services for materials, products, and construction methods as specified hereafter for the work.
- B. Costs: The costs of the initial services for testing and inspection personnel will be paid by the Owner. If initial tests indicate non-compliance with contract document requirements, any subsequent testing shall be performed by the same personnel and paid for by the contractor. Schedule portions of the work requiring testing and inspections services so as to be continuous and as brief as possible.
- C. Code Compliance Inspection and Tests: Inspections and tests not specified herein and required by codes and ordinances, or by plan approval authorities, and made by a legally constituted authority, shall be the responsibility of the contractor, unless otherwise specified.

1.3 REFERENCE STANDARDS

- A. General: Comply with the provisions of the latest versions of the publications listed below except as otherwise shown or specified.
- B. The Building Code as defined in the Structural Drawings.
- C. American Concrete Institute (ACI):
 - 1. ACI 301 Specifications for Structural Concrete
- D. American Institute of Steel Construction (AISC):
 - 1. AISC 341 Seismic Provisions for Structural Steel Buildings
 - 2. AISC 360 Specification for Structural Steel Buildings
- E. American National Standards Institute (ANSI)/American Society for Nondestructive Testing (ASNT):
 - 1. ANSI/ASNT CP-189-1995

2. ANSI/ASNT SNT-TC-1A
- F. American Society for Testing and Materials (ASTM). The following are specifically referenced for structural steel testing:
1. ASTM A435 Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
 2. ASTM A898 Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes
 3. ASTM E114 Standard Practice for Ultrasonic Pulse-Echo Straight Beam Contact Testing
 4. ASTM E164 Standard Practice for Contact Examination of Weldments
 5. ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
 6. ASTM E543 Standard Practice for Agencies Performing Non-destructive Testing
 7. ASTM E587 Standard Practice for Ultrasonic Angle-Beam Contact Testing
 8. ASTM E709 Standard Guide for Magnetic Particle Testing
 9. ASTM E1212 Standard Practice for Establishing Quality Management Systems for Nondestructive Testing Agencies
 10. ASTM E1444 Standard Practice for Magnetic Particle Testing
- G. American Society for Testing and Materials (ASTM). The following are specifically referenced for concrete testing:
1. ASTM C31 Practice for Making and Curing Concrete Test Specimens in Field
 2. ASTM C33 Specification of Concrete Aggregates
 3. ASTM C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
 4. ASTM C42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 5. ASTM C94 Specification for Ready-Mixed Concrete
 6. ASTM C143 Test Method for Slump of Hydraulic Cement Concrete
 7. ASTM C172 Practice for Sampling Freshly Mixed Concrete
 8. ASTM C173 Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method
 9. ASTM C192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
 10. ASTM C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 11. ASTM C597 Test Method for Pulse Velocity Through Concrete
 12. ASTM C803 Test Method for Penetration Resistance of Hardened

- | | | |
|-----|-----------|--|
| 13. | ASTM C805 | Concrete
Test Method for Rebound Number of Hardened
Concrete |
|-----|-----------|--|

H. American Welding Society (AWS):

- | | | |
|----|----------|---------------------------------|
| 1. | AWS D1.1 | Structural Welding Code – Steel |
|----|----------|---------------------------------|

I. Research Council on Structural Connections (RCSC):

- | | | |
|----|------|---|
| 1. | RCSC | Specification for Structural Joints Using High-Strength Bolts |
|----|------|---|

1.4 DEFINITIONS

- A. Testing Agency refers to the organization or group of organizations responsible for representing the Owner and performing all inspection, testing, and laboratory services as described herein.

1.5 SUBMITTALS

A. Testing agency shall submit the following:

1. The qualifications of the testing agency management and personnel designated to the project.
2. The testing agency "Written Practice for Quality Assurance."
3. Qualification records for Inspector and NDT technicians designated for the project.
4. The testing agency NDT procedures, equipment calibration records, and personnel training records.
5. The testing agency Quality Control Plan for the monitoring and control of the testing operations.
6. Welding Inspection Procedures.
7. Bolting Inspection Procedures.
8. Shear Connector Stud Inspection Procedures.

B. Test and Inspection Reports: The independent testing and inspection agency or agencies will prepare logs, test reports, and certificates applicable to specific tests and inspections and deliver copies distributed as follows:

1. 1 copy to the Owner
2. 1 copy to the Architect
3. 1 copy to the Structural Engineer
4. 1 copy to the General Contractor
5. Copy or copies, as required, to the building department (or as required by the authority having jurisdiction)

- C. Other tests, certificates, and similar documents shall be obtained by the Contractor and delivered to the Owner and/or Architect in such time as not to delay progress of the work or final payment therefore.
- D. Laboratory Reports: Furnish reports of materials and construction as required, including:
 - 1. Description of method of test.
 - 2. Identification of sample and portion of the work tested.
 - a. Description of location in the work of the sample.
 - b. Time and date when sample was obtained.
 - c. Weather and climatic conditions at time when sample was obtained.
 - 3. Evaluation of results of tests including recommendations for action.
- E. Inspection Reports: Furnish "Inspection at Site" reports for each site visit documenting activities, observations, and inspections, including notation of weather and climatic conditions, time and date, conditions and status of the work, actions taken, and recommendations or evaluation of the work.

1.6 QUALITY ASSURANCE

- A. Qualifications: All inspection and testing required to establish compliance with the contract document requirements, except as may be otherwise specified, shall be made by a prequalified, independent professional testing agency provided, and paid for by the Owner.
- B. Certification: Product producers and associations, which have instituted approved systems of quality control and which have been approved by document approval agencies, are not required to have further testing. Concrete mixing plants, plants producing fabricated concrete and wood or plywood products certified by the agency, lumber, plywood grade marked by approved associates, and materials or equipment bearing underwriters' laboratory labels require no further testing and inspection.
- C. Written Practice for Quality Assurance: The testing agency shall maintain a written practice for the selection and administration of inspection personnel, describing the training, experience, and examination requirements for qualification and certification of inspection personnel. The written practice shall describe the testing agency procedures for determining the acceptability of the structure in accordance with the applicable codes, standards, and specifications. The written practice shall describe the testing agency inspection procedures, including general inspection, material controls, visual welding inspection, and bolting inspection.
- D. Special Inspector Qualifications: All special inspectors shall be trained and competent in accordance with the quality assurance plan.

E. Welding Inspector Qualifications:

1. All welding inspectors shall meet the qualification as set forth in AWS D1.1.

F. Nondestructive Testing (NDT) Personnel Qualifications:

1. NDT personnel shall be qualified in accordance with AWS D1.1.

G. Bolting Inspector Qualifications: Each bolting inspector shall be trained and qualified to inspect bolting operations and high strength bolted connection for compliance with the Research Council on Structural Connections (RCSC) Specification and the Quality Assurance Plan. Competency shall be demonstrated through the administration of a written examination and through the hands-on demonstration by the Inspector of the methods to be used for bolt installation and inspection.

1.7 CONTRACTOR'S RESPONSIBILITY

- A. General: Coordinate quality control activities to avoid delay and to eliminate any need to uncover work for testing or inspection.
- B. Access: Furnish free access to the various parts of the work and assist testing and inspection personnel in the performance of their duties at no additional cost to the Owner.
- C. Data: Furnish records, drawings, certificates, and similar data as may be required by the testing and inspection personnel to assure compliance with the contract documents.
- D. Notice: Furnish notice to Owner and/or Architect and testing and inspection agency not less than 48 hours prior to any time required for such services.
- E. Defective Work: Remove and replace any work found defective or not complying with contract document requirements at no additional cost to the Owner. Where testing personnel take cores or cut-outs to verify compliance, repair prior to acceptance.
- F. Concrete: If test cylinders for concrete fail to meet design requirements, provide additional tests as may be directed by the Owner and/or Architect. Make core tests in accordance with ASTM C42 and load tests in accordance with ACI 318. Correct all deficiencies found in forms, reinforcing steel, and embedded objects.
- G. Structural Steel: Should any weld or structural connection fail to meet design requirements, provide additional testing for structural connections as directed by the Owner and/or Architect or Structural Engineer. Replace or repair all defective connections as directed.

1.8 TESTING AGENCY SERVICES

- A. General: Testing agency shall test or obtain certificates of tests of materials and methods of

construction, as described herein or elsewhere in the technical specification. The testing agency shall provide the management, personnel, equipment, and services necessary to perform the testing functions as outlined in this section.

- B. Inspection Services: The testing agency will have full authority to see that the work is performed in strict accordance with requirements of the contract documents and the directions of the Owner and/or Architect.
- C. Welding Procedure Review: The testing agency shall provide a review and approval or rejection of all welding procedures to be used and shall verify compliance with all reference standard requirements.

1.9 TESTS AND INSPECTION REPORTS

- A. Laboratory Reports: Furnish reports of materials and construction as required, includes description of method of test; identification of samples and portion of the work tested; description of location in the work of the sample, time and date when sample was obtained, weather and climatic conditions at time when sample was obtained, and an evaluation of results of tests including recommendations for action.
- B. Inspection Reports: Furnish "Inspection at Site" reports for each site visit documenting activities, observations, and inspections. Include notation of weather and climatic conditions, time and date, conditions and status of the work, actions taken, and recommendations or evaluation of the work.
 - 1. Include the following in all structural steel test and inspection reports (include all that apply):
 - a. Welder's certification
 - b. Weld qualification tests
 - c. Visual inspections
 - d. Review of materials testing procedures, including electrodes used, item inspected
 - e. Magnetic particle tests (MP)
 - f. Radiographic tests (RT)
 - g. Ultrasonic tests (UT)
 - h. Liquid Penetrant tests (LP)
 - i. High-strength bolted connection tests
 - 2. Include the following in all concrete test and inspection reports:
 - a. Exact mix used and maximum size aggregate
 - b. Location in building for which samples were taken
 - c. Cylinder identification
 - d. Date cylinder received in laboratory

- e. Slump data
- f. Concrete supplier's name
- g. Brand and type of cement used

1.10 REPORTING TEST FAILURES

- A. Immediately upon inspector's determination of a test failure, the inspector shall telephone results to the Contractor, Owner, and Architect. On the same day, the inspector shall distribute written test results.

1.11 TESTING AND INSPECTION

- A. Concrete Formwork: Inspect forms for location, configuration, camber, shoring, sealing of form joints, correct forming material, concrete accessories, and form tie locations. Contractor shall provide the inspector with a copy of the approved formwork/shoring shop drawings.
- B. Reinforcing Steel: All steel bars must be positively identified as to heat number and mill analysis.
 - 1. All steel bars that cannot be identified by heat number and mill analysis shall have one tensile and one bend test made for each 2 metric tons or fraction thereof, of each size and kind of reinforcing steel.
 - 2. Testing procedure shall conform to ASTM A615.
- C. Concrete Sampling and Testing:
 - 1. Perform the following services as required to assure compliance with requirements of Section 03 30 00, "Cast-In-Place Concrete," of this specification. The contractor shall notify the engineer and inspection-testing agency of the brand and type of cement and sources of aggregates in time for approval, sampling, and testing (if required).
 - 2. Batch Plant Inspection: Batch plant inspection by the inspector shall be as specified in the Building Code. Batch plant(s) shall continuously monitor and control fines content of arriving aggregate at plant prior to batching.
 - 3. Continuous Field Inspection: The inspector shall be present at all times during the placing of structural, reinforced concrete. Prior to placing concrete, the inspector shall inspect and approve, if satisfactory, accuracy of all formwork and quantity and placement of all reinforcing steel.
 - 4. Water: Test in accordance with ASTM C94 and CRC-C 400 as appropriate.
 - 5. Aggregates for normal weight concrete shall be sampled and tested in accordance with ASTM C33.
 - 6. Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C172. Concrete test specimen shall be produced from concrete directly exiting the chute of the truck delivering the concrete.
 - a. Air Content: Test for air content shall be performed in accordance with

- ASTM C173 or ASTM C231. A minimum of one test per day shall be conducted.
- b. Slump Tests: Slump tests shall be taken every 150 cubic yards delivered for each set of compression strength test cylinders, but not less than one test per hour during continuous pours. Slump shall be tested in accordance with ASTM C143.
 - c. Strength Tests: Strength tests per ASTM C39 shall be performed on test specimen prepared in accordance with either ASTM C192 for Laboratory Cured Specimen or ASTM C31 for Field Cured Specimen. Strength tests shall conform with the following:
 - 1) Test specimen (cylinders) shall be taken so as to represent as nearly as possible the batch of concrete from which they are taken.
 - 2) Tests shall be performed for each 150 cubic yards of each separate mix design of concrete or fraction thereof being placed each day.
 - 3) The quantity of test specimens shall be produced in order to achieve the following: At least one test at 7 days, at least one test at 28 days, and at least two tests for 6- by 12-inch cylinders or three tests for 4- by 8-inch cylinders at the specified test age as indicated on the structural drawings.
 - 4) An additional test specimen shall be produced should it be necessary to perform further testing. This specimen is to be discarded should the additional testing not be necessary.
 - 5) The strength level of an individual class of concrete for the cured specimen shall be satisfactory if both of the following requirements are met: (1) Average of all sets of three consecutive strength tests equal or exceed the specified compressive strength, (2) No individual class of concrete strength test (average of two cylinders) falls below the specified compressive strength by more than 500 psi.
 - 6) Report exact mix tested, minimum size aggregate, location of pour in the work, cylinder identification, date of receipt of cylinder in laboratory, cement brand and type, and admixtures used.
7. Investigation of Low-Strength Test Results: When any strength test of laboratory-cured or field-cured test cylinder falls below the specified strength requirement by more than 500 psi, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load- carrying capacity of the structure is not jeopardized.
- a. Nondestructive testing in accordance with ASTM C597, ASTM C803, or ASTM C805 may be permitted by the Owner and/or Architect to determine the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and

- correlated with other test data, shall not be used as a basis for acceptance or rejection.
- b. When strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by the Owner's representative to least impair the strength of the structure.
 - c. If the concrete in the structure will be dry under service conditions, the cores shall be air-dried (temperature 60 to 80 degrees F), relative humidity less than 60 percent for seven days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C42.
 - d. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement.
 - e. Repair core holes in the concrete found acceptable with an approved dry-pack or non-shrinking mortar.
 - f. If the core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Owner and/or Architect in accordance with the requirements of ACI 318.
 - g. Concrete work evaluated by structural analysis or by results of a load test and found deficient shall be corrected in a manner satisfactory to the Owner and/or Architect.
 - h. All investigations, testing, load tests, and correction of deficiencies shall be performed, and approved by the Owner and/or Architect, at the expense of the Contractor.

D. Masonry:

- 1. General: The inspection-testing agency shall verify compliance with the required inspection provisions of the Construction Documents and quality assurance program requirements of TMS402 and TMS602. The testing agency shall observe the preparation of grout specimens, mortar specimens, and prisms throughout the project.
- 2. Prior to the start of work, the testing agency shall verify the minimum design compressive strength (f_m) complies with the Construction Documents in accordance with TMS602 Article 1.4B.
- 3. As masonry construction begins, restarts after a delay of one month or more, or implements cold or hot weather procedures for the first time, the inspector shall be present at all times for

the first three days of substantial work to inspect and approve, if satisfactory:

- a. Removal of any laitance, loose aggregates, or other materials that would prevent mortar from bonding to the foundation.
 - b. Size and location of structural elements and movement joints.
 - c. Proportions and consistency of site-prepared mortar in accordance with ASTM C1586 and ASTM C780.
 - d. Construction of mortar joints in accordance with TMS602 Article 3.3B.
 - e. Grade, type, size, and location of reinforcement in accordance with TMS602 Articles 2.4 and 3.4.
4. During construction, the inspection-testing agency shall provide inspection and testing in accordance with TMS602 to ensure continual conformance with the Construction Documents and approved submittals. The method and frequency of tests and inspections shall be such that material proportions for mortar and grout are controlled and the quality of materials and construction are uniform throughout the project and shall include at a minimum:
- a. Testing of mortar once a week or every 5,000 square feet of wall consisting of:
 - 1) Visual inspection in accordance with ASTM C1586.
 - 2) Mortar aggregate ratio test in accordance with ASTM C780 Annex A4.
 - 3) Initial consistency and consistency retention or board life of masonry mortars using a modified concrete penetrometer in accordance with ASTM C780 Annex A3.
 - b. Samples of grout for slump and compressive strength tests shall be taken in accordance with ASTM C1019 every 100 cubic yards delivered. No samples shall be taken from the first or the last ten percent of a batch discharge.
5. Prior to grouting, the inspector shall ensure the following are in conformance with TMS602:
- a. Cleanouts conforming to Article 3.2F have been provided as required and grout spaces are clean and free of debris in accordance with Article 3.2D.
 - b. Grade, type, size, and location of reinforcement and anchor bolts in accordance with TMS602 Articles 2.4 and 3.4.
 - c. Block placement and mortar joints in accordance with Article 3.3B.
 - d. Proportions of site-prepared grout in accordance with Article 2.6B.

- e. For self-consolidating grout, slump flow and Visual Stability Index shall be tested at the start of each pour in accordance with Article 1.5 B.1.b.3.
- 6. The inspector shall be present at all times during grout placement to verify compliance with TMS602 Article 3.5.
- 7. When cold or hot weather procedures are implemented as required in Section 042000, “Unit Masonry,” the testing agency shall provide inspection of the handling, storage, preparation, protection, and placement of elements involved in structural masonry at least once daily.

E. Structural Steel – General:

- 1. Mill Certificates: Mill certificates or affidavits and manufacturer's certification shall be supplied to the inspector for verification of steel materials. Testing laboratory shall be notified at least three weeks in advance of fabrication and supplied with the reports so that shop inspection may be performed.
- 2. General Inspection:
 - a. Testing agency shall be at the fabricator's plant to verify that materials used match the mill tests or affidavits of test reports; that fabrication, welding procedures, surface preparation, and shop painting meet specifications; and that the work in progress conforms with project requirements.
 - b. Testing agency shall visually check fabricated steel delivered to the job to confirm that the work is in compliance with approved shop drawings and shall make any physical tests, measurements, etc., believed to be necessary.
 - c. Testing agency shall witness and report all corrections performed by the steel fabricator occurring on the fabricators own initiative.
 - d. Testing agency shall be present during steel erection at all times.
- 3. Welding Requirements: Special inspection shall be provided by the testing agency for all welding in accordance with the Building Code.
 - a. Review Welding Procedure Specifications to ensure conformance with AWS D1.1 Clauses 3, 4, 5, and 9, where applicable.
 - b. Review welder, welding operator, and tack welder qualifications to ensure conformance with AWS D1.1 Clauses 4 and 9, where applicable.
 - c. Nondestructive testing shall be performed as required by the Building Code, AWS D1.1, AISC 360 Chapter N, and as specified herein for all shop and field welds.

- d. All welds shall be visually inspected. Welds considered suspect shall be further checked by other means deemed necessary by the welding inspector.
- e. Ultrasonically test 100 percent of all complete joint penetration welds. Ultrasonically test 100 percent of all other partial joint penetration welds in connections of members in tension where the tension stress exceeds $0.3A_gF_u$. For partial joint penetration welds, rejections shall not be on the basis of the indication rating from the root area of the weld.
- f. Ultrasonically test all joints where the base metal is thicker than 1-1/2 inches and is subjected to through-thickness weld shrinkage strains. The joint shall be ultrasonically inspected for discontinuities directly behind such welds after joint completion.
- g. When ultrasonic indications arising from the weld root cannot be interpreted as either a weld defect or the backing strip itself, the backing strip shall be removed at the expense of the Contractor, and if no root defect is visible, the weld shall be re-tested. If no defect is indicated on this re-test, and no significant amount of weld metal has been removed, no further repair of welding is necessary. If a defect is indicated, it shall be repaired at no expense to the Owner.
- h. Perform magnetic particle tests of fillet welds larger than 3/8 inch.
- i. Perform magnetic particle tests of thermally cut surfaces of access holes when the flange thickness exceeds 2 inches for rolled shapes, or when the web thickness exceeds 2 inches for built-up shapes.
- j. The inspector shall perform magnetic particle testing in accordance with ASTM E709 for any questionable welds.
- k. See Specification Section 05 12 00, "Structural Steel Framing," for additional test/quality control requirements.
- l. Exceptions:
 - 1) When approved by the Building Official, Architect, and Structural Engineer, the rate of testing for ultrasonic testing of complete joint penetration welds may be reduced in accordance with the following:
 - a) The nondestructive testing rate for an individual welder or welding operator may be reduced to 25 percent, provided the reject rate is demonstrated to be 5 percent or less of the welds tested for the welder or welding operator. A sampling of at least 40 completed welds for a job shall be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable

- defects divided by the number of welds completed.
 - b) For complete joint penetration groove welds on materials less than 5/16 inch thick, nondestructive testing is not required provided continuous inspection is provided.
 - c) When approved by the Building Official, nondestructive ultrasonic testing may be performed in the shop of an AISC approved fabricator utilizing qualified welding inspections in the employment of the fabricator.
 - 2) Other ultrasonic or magnetic particle testing may be reduced by approval of the Owner and/or Architect and Structural Engineer upon presentation of satisfactory documentation submitted by the contractor.
- 4. Bolting Requirements: All inspection shall conform to the requirements of the current edition of the "Specification for Structural Joints Using High-Strength Bolts."
 - a. For connections using high-strength bolts installed using Load Indicating Washers, the Owner's testing agency need not be present during the entire installation and tightening operation, provided the Owner's testing agency provides the following:
 - 1) Inspection of the surface and bolt type for conformance to plans and specifications prior to the start of bolting.
 - 2) Verification of the minimum specified bolt tensions visually and by using the feeler gauge as "no go" inspection on a few bolts in each connection (10 percent or two bolts, whichever is greater).
 - b. For connection using high-strength tension control bolts, the Owners Testing Agency need not be present during the entire installation and tightening operation, provided the Testing Agency provides the following:
 - 1) Inspection of the surface and bolt type for conformance to plans and specifications prior to the start of bolting.
 - 2) Visual inspection of 100 percent of the high-strength bolts for properly installed tension.
- 5. Miscellaneous Metal: Where miscellaneous angles, channels, studs, and similar shapes are detailed for support of major components of the work, the welds, bolts, and material are subject to the same testing requirement as other structural supporting members.

F. Steel Decking:

1. General: Periodic inspection shall be provided for field attachment of all steel roof and floor decking; check and verify attachment and location of all closures and accessories.
2. Welding Inspection: In addition to the specified operator qualifications, prior to each welder starting work on the job and periodically as the testing agency determines, each welder shall perform a weld test to demonstrate to the inspector his ability to produce a satisfactory weld. The weld test shall be as follows:
 - a. Weld at least two samples of deck material to a base steel section simulating the framing with one weld each sample. Twist the deck sample with respect to the base until failure occurs. If the decking tears or if the welds shearing in torsion show the proper fusion area, the welds are satisfactory.
 - b. Questionable welding of the permanent decking shall be checked by the inspector by suitable means, including ultrasonic methods, if applicable.

G. Drill-In/Power-Driven Anchors: The testing agency shall verify procedures used for installation of all concrete anchors and monitor their installation for compliance with manufacturer's requirements.

H. Nonshrink Grout Sampling and Testing:

1. Perform the following services as required to assure compliance with this specification. The Contractor shall notify the Engineer and inspection-testing agency of the brand and type of nonshrink grout in time for approval, sampling, and testing (if required).
2. The Owner's testing agency shall test the grout for strength, height change, and fluidity daily in accordance with ASTM C1107.
 - a. Test specimen (cubes) shall be taken so as to represent as nearly as possible the batch of nonshrink grout from which they are taken.
 - b. Make three test specimens from a batch of nonshrink grout for each period of test or test age.
 - c. An additional test specimen shall be produced should it be necessary to perform further testing. This specimen is to be discarded should the additional testing not be necessary.
 - d. Report exact mix tested, location of nonshrink grout in the work, cube identification, date of receipt of cube in laboratory, and nonshrink grout brand and type.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION - NOT APPLICABLE

END OF SECTION

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

- B. Temporary utilities required include, but are not limited to:

Water service and distribution. (Contractor shall furnish and pay for his own water.)
Electric power and light. (Contractor shall furnish and pay for his own electric power and light.)
Telephone, FAX, and internet service. (Contractor shall furnish and pay for his own telephone and internet service.)

- C. Temporary construction and support facilities required include, but are not limited to:

Temporary heat.
Storage sheds.
Sanitary facilities, including soap and handwash facilities, and drinking water.
Dewatering facilities and drains.
Temporary enclosures.
Temporary Project identification signs.
Waste disposal services.
Rodent and pest control.
Construction aids and miscellaneous services and facilities.

- D. Security and protection facilities required include, but are not limited to:

Temporary fire protection.
Temporary fences, barricades, gates, warning signs, lights.
Environmental protection.

1.3 QUALITY CONTROL

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to

Building code requirements.
Health and safety regulations.

Utility company regulations.
Police, Fire Department and Rescue Squad rules.
Environment protection regulations.

- B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI A10 Series standards for "Safety Requirements for Construction and Demolition", and NECA Electrical Design Library "Temporary Electrical Facilities."
 - 1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.
 - 2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

- A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Water: Provide potable water approved by local health authorities.

2.2 EQUIPMENT

- A. General: Provide new equipment. If acceptable to the Architect/Engineer, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.
- B. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.
- C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
- D. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.
- G. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.
- H. First Aid Supplies: Comply with governing regulations.
- I. Fire Extinguishers: Provide hand-carried, portable UL-rated, Class "A" fire extinguishers for temporary office and similar spaces. In other locations provide hand-carried, portable, UL-rated, Class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.
 - 1. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.
- J. Project Identification Sign: The General Contractor shall furnish and install one project sign, to be located on the site where directed by the Architect/Engineer. The sign shall be constructed as indicated at the end of this section. There shall be no commercial advertising placed on the site.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the project adequately and result in minimum interference with performance of the work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.
 - 1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
- B. Temporary Lighting: Whenever overhead floor or roof deck has been installed, provide temporary lighting with local switch.

1. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.
- C. Temporary Telephones and Internet: Provide temporary telephone and internet service for all personnel engaged in construction activities, throughout the construction period.

3.3 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

- A. Locate storage sheds, sanitary facilities and other temporary construction and support facilities for easy access, but within temporary construction fence.
 1. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.
- B. Temporary Construction Heat: Provide temporary heat required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
 1. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control.
 - a. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited.
 2. Permanent systems will not be authorized for use until controls are operable and areas are clean and free of dust and debris and temporary filters placed on all return grilles.
- C. Temporary Comfort Heating and Cooling: If permanent HVAC is not operational, provide temporary heating, cooling and ventilation required for the comfort of occupants.
- D. Field Office: Provide insulated, weathertight temporary office of sufficient size to accommodate office personnel at the project site.
- E. Storage and Fabrication Sheds: Install storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on the site.
- F. Sanitary facilities to include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the project's needs.
 1. Provide toilet tissue, hand soap, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material.
- G. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
- H. Drinking Water Facilities: Provide containerized tap-dispenser bottled-water type drinking water units, including paper supply.

- I. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 33 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations and construction free of water.
- J. Temporary Enclosures: Provide temporary enclosure for protection of construction in progress and completed, from exposure, foul weather, other construction operations and similar activities.
 - 1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 - 2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.
 - 3. Close openings through floor or roof decks and horizontal surfaces.
- K. Temporary Exterior Lighting: Install exterior yard lights where required for safety and/or security.
- L. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 degrees F. (27 degrees C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.
- M. Rodent and Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures at regular intervals so the project will be relatively free of pests and their residues at Substantial Completion. Perform control operations in a lawful manner using environmentally safe materials.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- B. Enclosure Fence: Install around construction area as required for safety. Provide egress gates at locations where corridors exit the building. These gates shall be unlocked whenever the building is occupied. Provide Owner with keys to gates.
- C. Security Enclosure and Lockup: Install temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.
 - 1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

- D. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons on or near the site. Maintain erosion control devices. Comply with all local codes pertaining to these issues.
- E. Fire/Smoke: No plastic materials shall be used in temporary construction within the building.

3.5 OPERATION, TERMINATION AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.
 - 2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Termination and Removal: Unless the Architect/Engineer requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of the Contractor.
 - 2. Remove temporary stone that is not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances which might impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at the temporary entrances, as required by the governing authority.
 - 3. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
 - a. Replace significantly worn parts that have been subject to unusual operating conditions.
 - b. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.
 - c. Replace air filters immediately prior to Owner occupancy. New filters shall not come from attic stock.
 - d. Clean dirty coils.

END OF SECTION

SECTION 016600 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

1.3 RELATED WORK

- A. In general, the following related work is included in other sections of the specifications:
 - 1. Division 1 Section "Submittal Procedures" specifies requirements for submitting the Contractor's Construction Schedule and the Submittal Schedule.
 - 2. Division 1 Section "Substitution Procedures" specifies administrative procedures for handling requests for substitutions made after award of the Contract.

1.4 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - 2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
 - 3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.5 SUBMITTALS

- A. Product List: Prepare a list showing products specified in tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.
 - 1. Coordinate product list with the Contractor's Construction Schedule and the Schedule of Submittals.
 - 2. Form: Prepare product list with information on each item tabulated under the following column headings:
 - a. Related Specification Section number.
 - b. Generic name used in Contract Documents.

- c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
- 3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of an initial product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.
- 4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of the completed product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.
- 5. Architect's Action: The Architect will respond in writing to Contractor within 2 weeks of receipt of the completed product list. No response within this period constitutes no objection to listed manufacturers or products but does not constitute a waiver of the requirement that products comply with Contract Documents. The Architect's response will include a list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.6 QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.
 - 1. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.
- B. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each prime contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate contractors.
 - 2. If a dispute arises between prime contractors over concurrently selectable, but incompatible products, the Architect will determine which products shall be retained and which are incompatible and must be replaced.
- C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
 - 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
 - 6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
 - 7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
 - 1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 - 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selection Procedures: The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:
 - 1. Proprietary Specification Requirements: Where Specifications name only a single product or manufacturer, provide the product indicated. No substitutions will be permitted.
 - 2. Semiproprietary Specification Requirements: Where Specifications name 2 or more products or manufacturers, provide 1 of the products indicated. No substitutions will be permitted.
 - a. Where Specifications specify products or manufacturers by name, accompanied by the term "or equal" or "or approved equal," comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
 - 3. Nonproprietary Specifications: When Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
 - 4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated.
 - a. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.
6. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.
7. Visual Matching: Where Specifications require matching an established Sample, the Architect/Engineer's decision will be final on whether a proposed product matches satisfactorily.
 - a. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.
8. Visual Selection: Where specified product requirements include the phrase "... as selected from manufacturer's standard colors, patterns, textures ..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect/Engineer will select the color, pattern, and texture from the product line selected.
9. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 1 for allowances that control product selection and for procedures required for processing such selections.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
 1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 017100 – CONSTRUCTION TOLERANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes tolerances for the structural frame and construction surveying requirements:

1. General contractor's monitoring plan for the structural frame.
2. Vertical alignment tolerance.
3. Horizontal alignment tolerance.
4. Tolerance for embedded items.
5. Tolerance for cross-sectional dimensions of concrete elements.

- B. Related Sections:

1. 013300 – Submittal Procedures
2. 014500 – Structural Testing, Inspection, and Quality Assurance
3. 031000 – Concrete Forming and Accessories
4. 032000 – Concrete Reinforcing
5. 033000 - Cast-in-Place Concrete
6. 051200 – Structural Steel Framing
7. 053100 - Steel Decking

1.3 REFERENCE STANDARDS

- A. The latest versions of the publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

1. American Concrete Institute: ACI 117 - Standard Specification for Tolerances for Concrete
2. American Institute of Steel Construction: AISC 303 - Code of Standard Practice for Steel Buildings and Bridges

1.4 SUBMITTALS

- A. General: Make submittals in accordance with Section 01 33 00, "Submittal Procedures."

1.5 CONSTRUCTION TOLERANCE REQUIREMENTS

- A. The General Contractor is responsible for constructing the building within tolerance. The

tolerance of the structural frame shall be in accordance with the following industry standards, except where more stringent requirements are specifically noted in this Section.

1. American Concrete Institute: ACI 117 – Standard Specification for Tolerances for Concrete
 2. American Institute of Steel Construction: AISC 303 - Code of Standard Practice for Steel Buildings and Bridges
- B. Vertical Alignment. The following tolerance limits shall apply to all vertical members such as walls and columns.
1. Figure 1 illustrates the tolerance for vertical alignment of columns and walls.
- C. Horizontal Alignment. The following tolerance limits shall apply to horizontal alignment (i.e., plan location) of horizontal elements of the structural frame such as slab edges, beams, and girders.
1. The variation in the horizontal alignment of the work points of a steel beam shall be acceptable if caused solely by variations in steel column or concrete core wall alignment that are within the limits of Paragraph 1.5B. See Figure 2 - Section at Slab Edge.
 2. Edge forms for decks shall be field installed to a tolerance of ± 1 inch from the established building work lines. See Figure 2 - Section at Slab Edge.
 3. Slab edge position tolerance of formed concrete slabs shall be in accordance with ACI 117.
 4. The maximum offset in slab edge location between adjacent floors shall be $\pm 3/8$ inches. See Figure 2 - Offset Between Floors.
- D. Steel Elements Embedded in Concrete. The following tolerance limits shall apply to the placement of steel elements of the structure embedded into concrete.
1. Weld plates or angles embedded into the concrete may be oversized at contractor's option. Placement tolerance of embedded items shall be of ± 1 inch for both vertical and horizontal alignment.
 2. In-and-out tolerance for embedded plates shall be $1/8$ inch out of the concrete and $1/4$ inch into the concrete (recess).
- E. Cross-Sectional Dimensions of Concrete Elements. The following tolerance limits shall apply to the thickness of concrete elements such as walls, beams, and slabs.
1. The tolerance for slab thickness, including thickness of concrete on steel deck, shall be $+3/8$ inches and $-1/4$ inches.
 2. The tolerance for cross-sectional dimension of concrete walls and beams shall be $+1/2$ inches and $-3/8$ inches.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION - NOT APPLICABLE

END OF SECTION

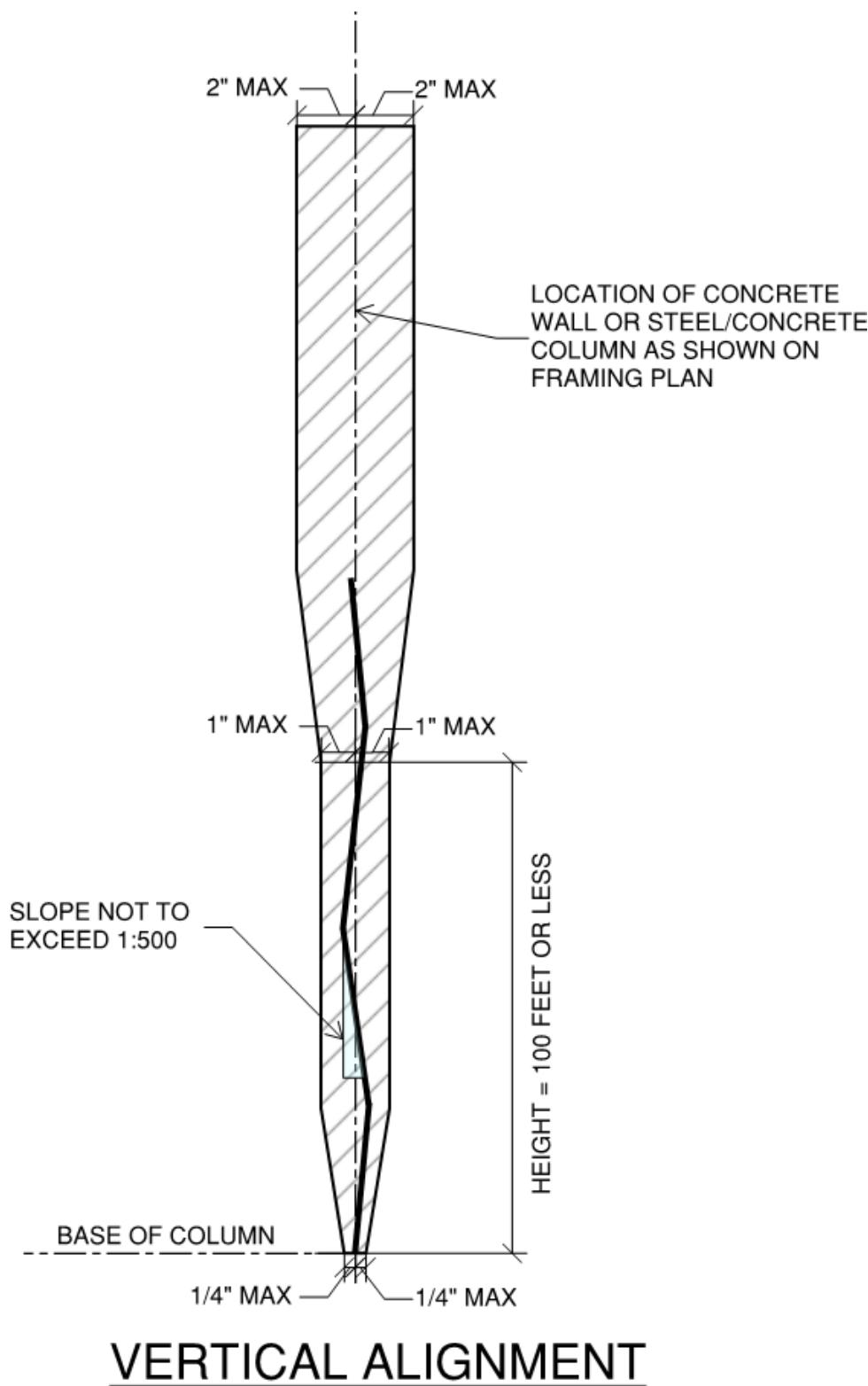


Figure 1: Vertical Alignment of Columns and Walls

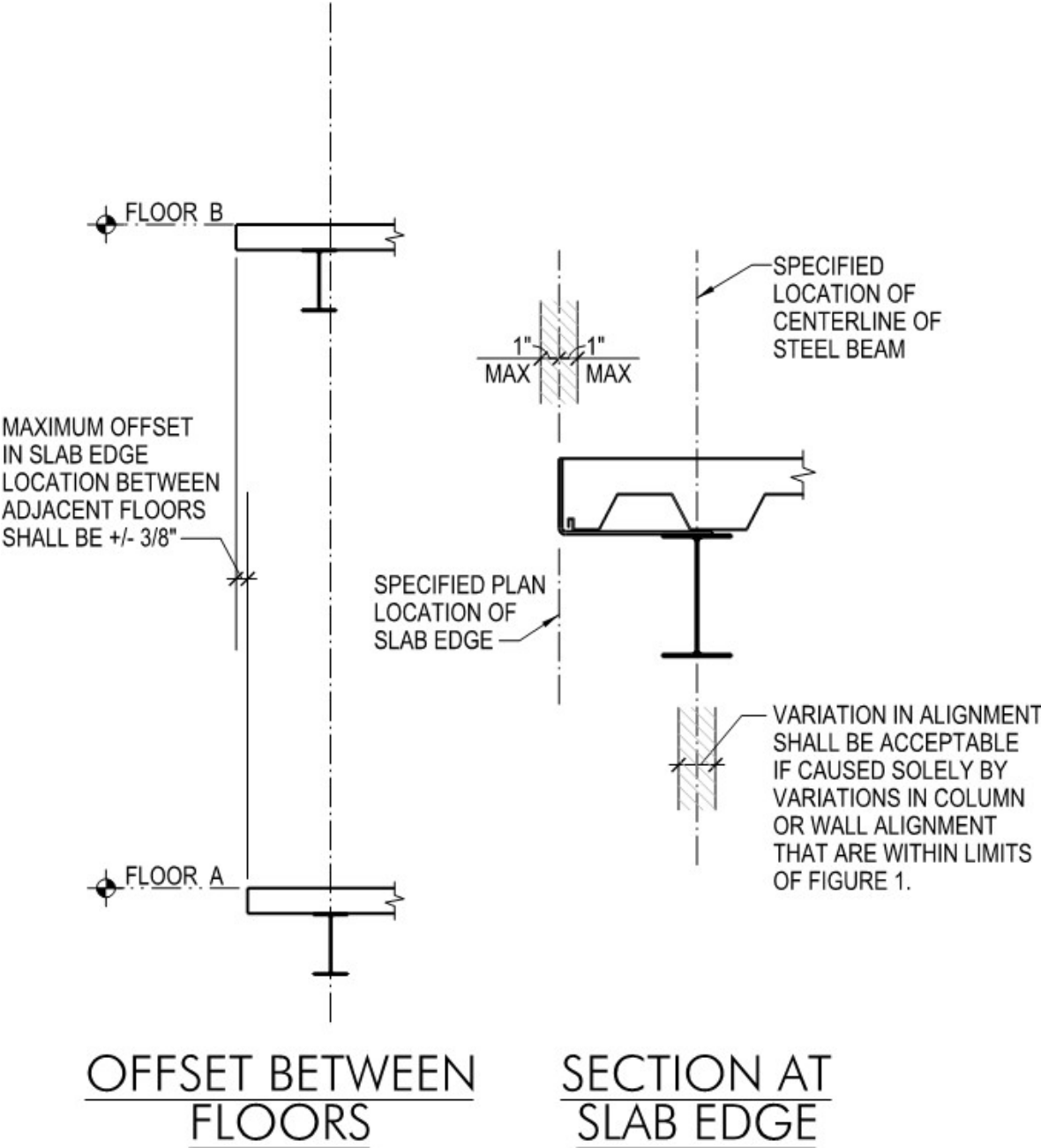


Figure 2: Horizontal Alignment

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for cutting and patching.
- B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - 1. Requirements of this Section apply to all Contracts. Refer to specifications for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.
 - 2. The Contractor shall use the File Management System prescribed by ZMM ARCHITECTS ENGINEERS to route and receive the documents detailed in this section.

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:
 - 1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
 - 2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
 - 3. List products to be used and firms or entities that will perform Work.
 - 4. Indicate dates when cutting and patching is to be performed.
 - 5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
 - 6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
 - 7. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.4 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.
 - 1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Foundation construction.

- b. Bearing walls.
 - c. Structural concrete.
 - d. Structural steel.
 - e. Lintels.
 - f. Primary wood framing.
 - g. Structural decking.
 - h. Stair systems.
 - i. Miscellaneous structural metals.
 - j. Equipment supports.
 - k. Piping, ductwork, vessels and equipment.
 - B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.
 - 1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Shoring, bracing, and sheeting.
 - b. Primary operational systems and equipment.
 - c. Water, moisture, or vapor barriers.
 - d. Membranes and flashings.
 - e. Fire protection systems.
 - f. Control systems.
 - g. Communication systems.
 - h. Conveying systems.
 - i. Electrical wiring systems.
 - C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.
 - 1. If possible, retain the original installer or fabricator to cut and patch the following categories of exposed Work, or if it is not possible to engage the original installer or fabricator, engage another recognized and experienced and specialized firm:
 - a. Processed concrete finishes.
 - b. Matched-veneer woodwork.
 - c. Preformed metal panels.
 - d. Acoustical ceilings.
 - e. Finished wood flooring.
 - f. Carpeting.
 - g. Wall covering.
 - h. HVAC enclosures, cabinets or covers.
- 1.5 WARRANTY
- A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
 - 1. Before proceeding, meet at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting existing pipe, conduit, or ductwork serving the building, but scheduled to be removed or relocated, until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible, review proposed procedures with the original installer; comply with the original installer's recommendations.
 - 1. In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
 4. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat.
- 3.4 CLEANING
- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This section specifies administrative and procedural requirements for project closeout, including but not limited to:
 - 1. Inspection procedures.
 - 2. Project record document submittal.
 - 3. Operating and maintenance manual submittal.
 - 4. Guarantee period.
 - 5. Final cleaning.
- B. Closeout requirements for specific construction activities are included in the appropriate sections of the specifications.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
 - 1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the work is not complete.
 - 2. Advise the Owner of pending insurance change-over requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
 - 4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
 - 5. Submit record drawings, maintenance manuals, final completion photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra stock, and similar items.
 - 7. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 - 8. Complete startup testing of systems and instruction of the Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleanup requirements, including touchup painting.
 - 10. Touch up and otherwise repair and restore marred, exposed finishes.

- B. Inspection Procedures: On receipt of a request for inspection for certification of Substantial Completion, the Architect/ Engineer will either proceed with the inspection or advise the Contractor of unfulfilled requirements necessary for the inspection. Following the inspection, the Architect/Engineer will prepare the Certificate of Substantial Completion, or advise the Contractor of construction items that must be completed or corrected before the certificate will be issued.
1. The General Contractor will prepare a punch list (example form attached to the end of this section) of defects and omissions to the requirements of the contract documents.
 2. This punch list will be provided to all subcontractors for corrective actions.
 3. The General Contractor's superintendent, along with the foreman of the applicable subcontractors, will each be required to initial and date each item completed on their respective punch lists.
 4. Architect/Engineer will be notified when the items have been completed.
 5. The Architect/Engineer and/or Owner will verify that these items have been completed and will initial and date each item on the respective punch lists. If the Architect/Engineer or Owner observe additional items needing correction, they will add these items to the punch list for corrective measures by the appropriate contractor.
 6. Completion of the punch list items will form the basis for substantial completion.
 7. Once the Certificate of Substantial Completion has been issued with the list of any minor unfulfilled requirements (punch list) and agreed upon date for Final Acceptance, the Contractor will continue to fully complete the Work.

1.4 FINAL ACCEPTANCE

- A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following.
1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted.
 2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
 3. Submit a certified copy of the Architect/Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Architect/Engineer.
 4. Submit consent of surety to final payment.
 5. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 6. Submit statement to Architect/Engineer certifying that all temporary and permanent materials used on this project are asbestos-free.
 7. Submit test results to Architect/Engineer certifying that the project's domestic water system is not at risk for lead.
 8. Submit a final "liquidated damages" settlement statement.
 9. Submit a final "reimbursement of Architect" settlement statement.
- B. Completion Verification Procedure: The Architect/Engineer will verify completion of the Work upon receipt of notice that the Work, including inspection list (punch list) items from earlier inspections, has been completed and documented with General Contractor's initials and date, and with Subcontractor's initials and date.
1. Upon verification of completion, the Architect will prepare a certificate of final acceptance. If the Work is incomplete, the Architect will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

1.5 RECORD DOCUMENT SUBMITTALS

- A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Architect/Engineer's reference during normal working hours.
- B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
 - 1. Mark record set with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
 - 2. Mark new information that is important to the Owner, but was not shown on Contract Drawings.
 - 3. Note related Change Order numbers where applicable.
 - 4. Organize record drawing sheets into a manageable set, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Note related Change Orders, Record Drawings, and Product Data, where applicable.
- D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.

1.6 OPERATION AND MAINTENANCE DATA

- A. At time of completion, the Contractor shall furnish to the Owner complete operating and maintenance instructions for all mechanical equipment and electrical equipment in the project together with the names and addresses of the applicable subcontractors and suppliers. The manuals shall also contain spare parts listings, copies of warranties, wiring diagrams, and inspection procedures.
 - 1. Provide two (2) paper copies bound in a loose leaf notebook.
 - 2. Provide one (1) digitized copy on CD or USB Drive in electronic format (PDF).

1.7 GUARANTEE

- A. All materials, equipment and workmanship shall be guaranteed for one year from the date of Certificate of Occupancy, not from date of installation. Longer period of guarantee where called for in specifications shall take precedence over the one year guarantee.

- B. During the Guarantee Period, the Owner shall contact the Contractor directly on guarantee/warranty items as they occur. The Owner shall utilize the form at the end of this section.

1.8 GUARANTEE PERIOD INSPECTION

- A. Prior to the expiration date of the Contractor's one-year guarantee period, but not before 9 months of this period has elapsed, the Owner shall make an inspection of the building, equipment, and/or any other work included in the original Contract to determine whether any defects in materials or workmanship have developed. The Owner shall provide the Contractor with written notice of such defects. A copy of this written notice shall be sent to the Architect/Engineer.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and anti-pollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.

- l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical, electrical, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Clean areas of existing buildings and site that were affected by construction dust. These areas will be identified solely by the Owner.
 - t. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.
- D. Contractor shall not use the Owner's refuse containers.

END OF SECTION

017700A Punch List Form

GUARANTEE REPORT FORM

DATE: _____

(Mr. _____) (General Contractor)

(_____ Company _____)

(_____ Address _____)

(_____ Address _____)

(_____ FAX Number _____)

RE: (Construction Project Title)
GUARANTEE ITEM

Gentlemen:

This notice is in regards to a guarantee item on the referenced construction project.

GUARANTEE REPORT NO. _____

DESCRIPTION OF DEFECT:

REPORTED BY: _____ *

REQUIRED DATE FOR REPAIR: _____

DATE OF DISCOVERY: _____ (date) _____ (By Owner)

DATE GENERAL CONTRACTOR
NOTIFIED THE
APPROPRIATE SUBCONTRACTOR: _____ (date) _____ (By General Contractor)

DATE ITEM REMEDIED: _____ (date) _____ (By General Contractor)

DATE THIS FORM RETURNED TO OWNER: _____ (date) _____ (By General Contractor)

GUARANTEE PERIOD EXPIRES: _____ (date) _____ (By Owner)

Sincerely,

(Mr./Ms. _____) (Owner)

(_____ Company _____)

(_____ Address _____)

(_____ Address _____)

(_____ FAX Number _____)

* Please return this form to me when repair has been accomplished.

SECTION 017800 - WARRANTIES

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section specifies general administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers standard warranties on products and special warranties.
 - 1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
 - 2. General closeout requirements are included in Section 017700, CLOSEOUT PROCEDURES.
 - 3. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions 2 through 26.
 - 4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- E. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

- A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.
- B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Architect for approval prior to final execution.
 - 1. Refer to individual Sections of Divisions 2 through 26 for specific content requirements, and particular requirements for submittal of special warranties.
- C. Form of Submittal: At Final Completion, compile two copies of each required warranty properly executed by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- D. Bind warranties in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
 - 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
 - 2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES", the Project title or name, and the name of the Contractor.
- E. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training CD(s), DVD(s) and/or USB Drive(s).

1.3 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module.
 - 1. At completion of training, submit one complete training manual for Owner's use.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Demonstration and Training CD(s), DVD(s) and/or USB Drive(s): Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date CD(s), DVD(s) and/or USB Drive(s) was/were recorded.
 - f. Description of vantage point, indicating location.
 - 2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding CD(s), DVD(s) and/or USB Drive(s). Include name of Project and date of recording on each page.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, experienced in operation and maintenance procedures and training.
- B. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.

- C. Preinstruction Conference: Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved operating and maintenance manuals. Do not submit instruction program until operating and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
 - 1. Heat generation, including boilers, pumps, steam distribution piping, and water distribution piping.
 - 2. Refrigeration systems, including chillers, cooling towers, condensers, pumps, and distribution piping.
 - 3. HVAC systems, including air-handling equipment, air distribution systems, and terminal equipment and devices.
 - 4. HVAC instrumentation and controls.
 - 5. Lighting equipment and controls.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Regulatory requirements.
 - c. Equipment function.
 - d. Operating characteristics.
 - e. Limiting conditions.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency.
 - b. Operating and Maintenance manuals.

- c. Project Record Documents.
- d. Identification systems.
- e. Warranties and Bonds.
- f. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- C. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING CD(s), DVD(s) AND/OR USB DRIVE(s)

- A. General: Engage a qualified commercial photographer to record demonstration and training CD(s), DVD(s) and/or USB Drive(s). Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Recording Format: Provide high-quality CD(s), DVD(s) and/or USB Drive(s).
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
- D. Narration: Describe scenes on CD(s), DVD(s) and/or USB Drive(s) by audio narration by microphone while CD(s), DVD(s) and/or USB Drive(s) is/are recorded. Include description of items being viewed. Describe vantage point, indicating location.

END OF SECTION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The work to be performed under this section of the specifications comprises the furnishing of all labor and materials and the completion of all work of this section as shown on the drawings and/or herein specified.
- B. In general, the work included under this section consists of, but is not limited to, the following:
 - 1. Removal of existing suspended acoustical tile ceiling, lighting, mechanical units, exterior glass block, etc.

1.3 RELATED WORK

- A. In general, the following related work is included in other sections of the specifications:
 - 1. Remodeling construction work and patching is included within the respective sections of specifications, including removal of materials for re-use and incorporated into remodeling or new construction.
 - 2. Relocation of pipes, conduits, ducts, other mechanical and electrical work is specified by respective trades.

1.4 JOB CONDITIONS

- A. Owner will continuously occupy areas of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities which will severely impact Owner's normal operations.
- B. Owner assumes no responsibility for actual condition of items or structures to be demolished.
 - 1. The Owner will maintain conditions existing at time of commencement of contract insofar as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
- C. Remove items indicated to be removed, but of salvable value to Contractor, from structure as work progresses. Transport salvaged items from site as they are removed.
 - 1. Storage or sale of removed items on site is not permitted.
- D. Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.
 - 1. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to and from occupied portions of building.

2. Erect temporary covered passageways as required by authorities having jurisdiction.
 3. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished, and adjacent facilities or work to remain.
 4. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
 5. Protect floors with suitable coverings when necessary.
 6. Construct temporary insulated solid dust-proof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dust-proof doors and security locks if required.
 7. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces, and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
 8. Remove protections at completion of work.
- E. Promptly repair damages caused to adjacent facilities by demolition work at no additional cost to Owner.
- F. Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
1. Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- G. Use of explosives is not permitted.
- H. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
- I. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.
1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
- 1.5 SUBMITTALS
- A. Submit schedule indicating proposed methods and sequence of operations for selective demolition work to Owner's representative for review prior to commencement of work. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.
- B. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
- C. Coordinate with Owner's continuing occupation of portions of existing building, with Owner's partial occupancy of completed new addition, and with Owner's reduced usage during summer months.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to commencement of demolition work, inspect areas in which work will be performed. Photograph existing conditions to structure surfaces, equipment or to surrounding properties which could be misconstrued as damage resulting from selective demolition work; file with Owner's representative prior to starting work.

3.2 PREPARATION

- A. Temporary Shoring: Contractor shall design, provide and maintain shoring, bracing and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished, or adjacent construction and finishes to remain
 - 1. Strengthen or add new supports when required during progress of selective demolition.
 - 2. Cease operations and notify the Owner's representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.
- B. Cover and protect furniture, equipment and fixtures to remain from soiling or damage when demolition work is performed in rooms or areas from which such items have not been removed.
- C. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to occupied portions of the building.
 - 1. Where selective demolition occurs immediately adjacent to occupied portions of the building, construct dust-proof partitions of minimum 4" studs, 5/8" drywall (joints taped) on occupied side, 1/2" fire-retardant plywood on demolition side, and fill partition cavity with sound-deadening insulation.
 - 2. Provide weatherproof closures for exterior openings resulting from demolition work.
 - 3. Existing ceiling tiles shall be removed in accordance with the recommendations of the IAQA Mold Remediation Certification Program.
- D. Locate, identify, stub off and disconnect utility services that are not indicated to remain.
 - 1. Provide by-pass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours advance notice to Owner if shut-down of service is necessary during change-over.

3.3 DEMOLITION

- A. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on drawings in accordance with demolition schedule and governing regulations.
 - 1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
 - a. Provide new lintels at new openings in existing masonry walls as indicated.

2. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors or framing.
3. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
4. Demolish foundation walls to a depth of not less than 12" below existing ground surface. Demolish and remove below-grade wood or metal construction. Break up below-grade concrete slabs.
5. For interior slabs on grade, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible.
6. Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel or sand, free of trash and debris, stones over 6" diameter, roots or other organic matter.

- B. Upon encountering unanticipated mechanical, electrical or structural elements which conflict with intended function or design, investigate and measure both nature and extent of the conflict. Submit report to Owner's representative in written, accurate detail. Pending receipt of directive from Owner's representative rearrange selective demolition schedule as necessary to continue overall job progress without delay.

3.4 REFRIGERANT RECOVERY

- A. The Contractor shall have a licensed refrigerant recovery technician evacuate all refrigerants from all refrigeration equipment being removed in accordance with EPA guidelines and regulations. The Contractor shall take all necessary precautions to not accidentally vent refrigerants to the atmosphere. The refrigerant shall become the property of the Contractor.

3.5 SALVAGE MATERIALS

- A. Where indicated on drawings as "Salvage-Deliver to Owner," carefully remove indicated items, clean, store, and turn over to Owner and obtain receipt.
 1. Historic artifacts, including cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historic significance remain the property of the Owner. Notify Owner's representative upon encountering such items and obtain acceptance regarding method of removal and salvage for Owner.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove debris, rubbish, and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site.
 1. Upon encountering hazardous materials during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution.
 2. Burning of removed materials is not permitted on project site.

3.7 CLEAN-UP AND REPAIR

- A. Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protections and leave interior areas broom clean.

- B. Repair demolition performed in excess of that required. Return structures and surfaces to remain to condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION

SECTION 031000 – CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section covers design, construction, treatment of formwork to confine and shape concrete to the required dimensions, and formwork accessories.
- B. Related Sections:
 - 1. 013300 – Submittal Procedures
 - 2. 014500 – Structural Testing, Inspection, and Quality Assurance
 - 3. 032000 – Concrete Reinforcing
 - 4. 033000 – Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

- A. The latest versions of the publications listed below form a part of this Specification; comply with provisions of these publications except as otherwise shown or specified.
 - 1. ACI 117 Standard Specification for Tolerances for Concrete
 - 2. ACI 301 Standard Specifications for Structural Concrete, including other standards referred to in ACI 301, such as ASTM, etc.

1.4 SUBMITTALS

- A. Formwork Shop Drawings: Submit the following in accordance with Section 01 33 00, "Submittal Procedures":
 - 1. Formwork shop drawings sealed by an engineer licensed to perform the work in the jurisdiction where the project is located.
 - 2. Calculations for formwork, reshoring, and backshoring sealed by an engineer licensed to perform the work in the jurisdiction where the project is located.
 - 3. Exposed Concrete Surfaces: Show the general construction of forms including jointing, formed joints or reveals, form tie locations, and pattern of form placement, and other items that affect the exposed concrete visually.
 - 4. Formwork Facing Materials: Data on form facing materials proposed for smooth-form finish.

- B. Product Data: Include specifications and installation instructions for proprietary materials and items as required, including formwork release agents, form liners, manufactured form systems, form ties, and accessories.
- C. Construction and Contraction Joints: Submit the location of construction and contraction joints proposed if different from those indicated in the Contract Documents.
- D. Testing for Formwork Removal: Data on method for determining strength of concrete for removal of formwork when a method other than field- cured cylinders is proposed.
- E. Formwork Removal Plans: Detail plans for formwork removal operations when removal of forms at concrete strengths lower than that specified is proposed.
- F. Reshoring and Backshoring Plans: When reshoring or backshoring is required or permitted, submit procedures and plans of operations, before use, sealed by an engineer licensed to perform the work in the jurisdiction where the project is located.

1.5 QUALITY ASSURANCE

- A. Design and construction of concrete formwork is the responsibility of the Contractor. Design and construct formwork to furnish only those lines and shapes indicated on drawings, unless otherwise approved by Architect. Construct formwork for erection in satisfactory sequence and removal without damage to the resulting concrete surface.
- B. Professional Engineer Qualifications: A professional engineer who is registered in the jurisdiction where the project is located and who is experienced in providing engineering services of the kind indicated.
- C. Allowable Tolerances: Variations from plumb and designated building lines shall not exceed the tolerances specified in ACI 117.
- D. Inspections: Refer to Section 01 45 00, "Structural Testing, Inspection, and Quality Assurance," for inspection requirements performed by Owner's Testing Agency.
- E. Embedded Items: Where items, such as embedded plates, reglets, anchors, fastenings, conduit, piping and other items are supplied by other trades and specified elsewhere in the Contract Documents, coordinate and obtain approval of their placement in the forms prior to placing any concrete.
- F. Forms for Reuse: Where applicable, construct and erect forms for reuse; withdraw all projecting nails and other objects from contact surfaces before reusing; clean and completely recondition all forms prior to reuse. Obtain approval for form reuse from Owner's Inspector;

formwork with patches and repairs affecting the appearance of concrete surfaces will not be allowed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Form-Facing Materials: Materials for form faces in contact with concrete shall meet the following requirements unless otherwise specified in the Contract Documents.
 - 1. Rough Form Finish: No form-facing material is specified.
 - 2. Smooth Form Finish: Use plywood, tempered concrete form-grade hardboard, metal, plastic, paper, or other acceptable materials capable of producing the desired finish. Form-facing materials shall produce a smooth, uniform texture on the concrete. Do not use form-facing materials with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the texture of concrete surfaces. Set the facing materials in an orderly and symmetrical arrangement, and keep the number of seams to a practical minimum.
- B. Formwork Accessories: Use commercially manufactured formwork accessories that are partially or wholly embedded in concrete, including ties and hangers. Do not use non-fabricated wire form ties. Where noted in the Contract Documents, use form ties with integral water barrier plates in walls.
- C. Formwork Release Agents: Use commercially manufactured formwork release agents that will prevent formwork absorption of moisture, prevent bond with concrete, and not stain the concrete surfaces.
- D. Expansion Joint Filler: Premolded expansion joint filler shall conform to ASTM D994, ASTM D1751, or ASTM D1752.
- E. Other Embedded Items: Use waterstops, sleeves, inserts, anchors, reglets, dovetail anchor slots, and other embedded items of the material and design indicated in the Contract Documents.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Design and engineering of formwork shall be the responsibility of the Contractor.
- B. Design formwork, shores, reshores, and backshores to carry all loads transmitted to them and to comply with the requirements of the applicable building code. Design formwork to withstand the pressure resulting from placement and vibration of concrete and to maintain specified tolerances.

- C. Do not use earth cuts as forms for vertical or sloping surfaces unless required or permitted by Contract Documents.
- D. Maximum deflection of facing materials reflected on concrete surfaces exposed to public view shall be $L/240$ of the span between structural members of the formwork.
- E. Formed Construction: Locate and form construction joints that least impair the strength of the structure. Unless otherwise specified or permitted, locate and detail formed construction joints to the following requirements:
 - 1. Locate construction joints within the middle third of the spans of slabs, beams, and girders. When a beam intersects a girder at this point, offset the joint in the girder a distance equal to or greater than twice the width of the beam.
 - 2. Locate joints in walls and columns at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs.
 - 3. Make joints perpendicular to the main reinforcement.
 - 4. Provide keyways as indicated in the Contract Documents.

2.3 FABRICATION AND MANUFACTURE

- A. Formwork shall be tight to prevent loss of mortar from concrete.
- B. Place 3/4-inch minimum chamfer strips in the corners of formwork to produce beveled edges on permanently exposed surfaces unless otherwise specified. Do not bevel re-entrant corners or edges of formed joints of concrete unless specified in the Contract Documents.
- C. Provide temporary openings at the base of column and wall formwork and at other points where necessary to facilitate cleaning and inspection. Arrange such openings in sides of forms where concrete surfaces will be concealed by other materials or construction. Clean and inspect immediately before concrete is placed.
- D. Fabricate form ties so ends or end fasteners can be removed with minimum spalling at the faces of concrete.
- E. Locate waterstops in joints where indicated in the Contract Documents. Use pieces of pre-molded waterstop with a maximum practical length to hold the number of end joints to a minimum. Make joints in waterstops in accordance with the manufacturer's recommendations.

PART 3 - EXECUTION

3.1 CONSTRUCTION AND ERECTION OF FORMWORK

- A. At construction joints, lap contact surface of the form sheathing for flush surfaces exposed to view over the hardened concrete in the

previous placement by 1 inch minimum. Ensure formwork is held firmly against hardened concrete to prevent offsets or loss of mortar at construction joints and to maintain a true surface.

- B. Construct formwork so concrete surfaces conform to the tolerance limits of ACI 117.
- C. Provide positive means of adjustment (wedges or jacks) for shores and struts. Make adjustments in the formwork prior to concrete placement. Fasten form wedges in place after final adjustment of forms. Brace formwork securely against lateral deflection and lateral instability.
- D. Camber formwork to compensate for anticipated formwork deflections. Set formwork and intermediate screed strips for slabs accurately to produce designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibration screeds or roller pipe screeds when the finish specified requires the use of such equipment.
- E. When formwork is cambered, set screeds to a like camber to maintain required concrete thickness.
- F. Anchor formwork to shores, supporting surfaces, or members to prevent upward or lateral movements of the formwork system during concrete placement.
- G. Construct formwork for wall openings to facilitate removal and to counteract swelling of wood formwork.
- H. Place sleeves, inserts, anchors, and embedded items required for adjoining work or form support of adjoining work before concrete placement.
- I. Position and support expansion joint materials, waterstops, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
- J. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign materials before concrete is placed.
- K. Cover surfaces of formwork with an acceptable material that will prevent bond with the concrete. A field-applied formwork release agent or a factory-applied liner may be used. If a formwork release agent is used, apply following these guidelines:

1. Apply to the surfaces of the formwork in accordance with the manufacturer's recommendations before placing reinforcing steel.
2. Do not allow formwork release agent to puddle in the forms.
3. Do not allow formwork release agent to make contact with reinforcing steel or hardened concrete against which fresh concrete is to be placed.

3.2 REMOVAL OF FORMWORK

- A. When finishing is required, remove forms as soon as removal operations will not damage concrete.
- B. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform needed repairs or required treatments at once, and follow immediately with specified curing.
- C. Loosen wood formwork for wall openings when this can be accomplished without causing damage to the concrete.
- D. Leave formwork and shoring in place to support the weight of concrete in beams, slabs, and in-place structural members until concrete has reached the specified compressive strength. If a lower compressive strength is proposed for removal of formwork and shoring, submit detailed plans for review and acceptance. When shores and other vertical supports are arranged to allow the form-facing material to be removed without loosening or disturbing the shores and supports, the facing material may be removed at an earlier age.
- E. Construct formwork to permit easy removal.

3.3 RESHORING AND BACKSHORING

- A. During reshoring and backshoring, do not allow concrete in beam, slab, column, or any structural member to be loaded with combined dead and construction loads in excess of the design loads indicated in the Contract Documents at the specified concrete compressive strength.
- B. Place reshores and backshores in sequence with stripping operations.
- C. Tighten reshores and backshores to carry the required loads without overstressing the concrete members. Leave them in place until required tests indicate the concrete compressive strength has attained the minimum value specified.

- D. For floors supporting shores under newly placed concrete, either leave the original supporting shores in place or install reshores and backshores. The shoring system and the supporting slabs shall have capacities sufficient to resist the anticipated loads. Locate reshores and backshores directly under a shore position.
- E. Extend reshoring or backshoring over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads such that the design loads of the floors supporting the shores, reshores, or backshores are not exceeded.

3.4 STRENGTH OF CONCRETE REQUIRED FOR REMOVAL OF FORMWORK

- A. Vertical formwork not supporting the weight of concrete may be removed 24 hours after concrete placement, provided the concrete is hard enough to not be damaged and curing and protection operations are continued.
- B. Formwork Supporting Weight of Concrete
 - 1. For conventionally reinforced slabs:
 - a. After the concrete has been in place at least 3 days and has reached 75% of required design compressive strength, reshoring will be permitted, provided concrete does not remain unsupported more than 4 hours.
 - b. Leave reshoring in place at least 7 days after concrete placement and until concrete design compressive strength is attained.
- C. When removal of formwork or reshoring is based on concrete reaching a specified compressive strength, concrete will be presumed to have reached this strength when test cylinders, field cured the same as the concrete they represent, have reached the compressive strength specified for removal of formwork and/or reshoring. Mold cylinders in accordance with ASTM C31, and cure them under the same conditions for moisture and temperature as used for the concrete they represent. Test cylinders in accordance with ASTM C39.
- D. Alternatively, one of the following methods for evaluating concrete strength for formwork removal may be used, provided sufficient data is submitted, using project materials, to demonstrate correlation of measurements on the structure with the compressive strength of laboratory-cured molded cylinders or drilled cores. Submit correlation data on the proposed alternative method for determining strength to the Architect/Engineer.
 - 1. Tests of cast-in-place cylinders in accordance with ASTM C873 (limited to slabs with concrete depths from 5 to 12 inches)
 - 2. Penetration resistance in accordance with ASTM C803
 - 3. Pullout strength in accordance with ASTM C900
 - 4. Acceptable maturity-factor procedure in accordance with ASTM C1074
 - 5. Break-off number of concrete in accordance with ASTM C1150

END OF SECTION

SECTION 032000 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section covers materials, fabrication, placement, and tolerances of reinforcement and reinforcement accessories.

- B. Related Sections:

- 1. 013300 – Submittal Procedures
 - 2. 014500 – Structural Testing, Inspection, and Quality Assurance
 - 3. 031000 – Concrete Forming and Accessories
 - 4. 033000 – Cast-in-Place Concrete
 - 5. 042000 – Unit Masonry

1.3 REFERENCE STANDARDS

- A. The latest versions of the publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

- 1. ACI 117 Standard Specification for Tolerances for Concrete
 - 2. ACI 301 Standard Specifications for Structural Concrete, including other standards referred to in ACI 301, such as ASTM, AWS, etc.
 - 3. CRSI MSP Manual of Standard Practice
 - 4. International Code Council, Evaluation Services (ICC-ES): Evaluation Reports
 - 5. International Association of Plumbing and Mechanical Officials: Uniform Evaluation Service (IAPMO-UES)

1.4 SUBMITTALS

- A. General: Submit the following data and drawings for review and acceptance before fabrication and execution in accordance with Section 01 33 00, "Submittal Procedures."
- B. Placing Drawings: Submit placing drawings showing fabrication dimensions and locations for placement of reinforcement and reinforcement supports. Indicate splicing, laps, details of reinforcing, and accessories.
 - 1. Show embedded plates, bolts, etc., for purposes of checking for potential interferences.

2. Indicate locations of construction joints in the concrete construction.
- C. Mechanical Splices: Submit the types of mechanical splices proposed for use. Include the latest ICC-ES (or IAPMO-ES equivalent) Reports for threaded or sleeve-type splices to verify compliance with specified requirements.
- D. Headed Bars or Terminators: Submit the types of headed bars or terminators proposed for use. Include the latest ICC-ES (or IAPMO-ES equivalent) reports to verify compliance with the specified requirements.
- E. Product Data: Include specifications and installation instructions for all proprietary materials and reinforcement accessories.
- F. Welding Procedures and Qualifications: Submit description of reinforcement weld locations, welding procedures, and welder qualifications when welding is permitted.
- G. Mill Certificates: Submit mill certificates for all reinforcing steel for information and record only.
- H. Environmental Product Declarations (EPDs): For reinforcement types, submit product-specific Type III EPDs conforming to ISO 14025 and ISO 21930 including Life Cycle Assessment Modules A1-A3 which at a minimum must include Global Warming Potential (GWP). Submit EPDs for a minimum of 90 percent by weight of all reinforcement types used in the project.
- I. Recycled Content: For LEED v4 documentation and points, submit documentation of the materials percent recycled content compared to totals, measured by weight or volume.
- J. Bill of Materials: Submit reinforcement weights per structural element and grade as outlined in table below prior to start of construction and at completion of construction based on material delivered to project site.

ELEMENT	GRADE (KSI)	WEIGHT (US ton or metric tonne)	GWP (kg CO ₂ eq/ metric tonne)
SLABS	60		
BEAMS	60		
COLUMNS	60		
COLUMNS	80		
SHEAR WALLS	60		
SHEAR WALLS	80		
MAT FOUNDATION	60		
MAT FOUNDATION	80		
MISC CONCRETE, CURBS, SIDEWALKS	60		

NOTES:

- SUPPLIER TO SUBMIT TABLE USING PROJECT-SPECIFIC INFORMATION.
- SUPPLIER TO REPORT ANY ASSUMPTIONS AND ALLOWANCES INCLUDED IN AMOUNTS.

1.5 QUALITY ASSURANCE

- Allowable Tolerances: Fabrication and placement tolerances shall be in accordance with ACI 117.
- Welder Qualifications: Welders shall be qualified in the last six months in accordance with the American Welding Society, AWS D1.4. Welding procedures qualified by others and welders qualified by another employer may be acceptable as permitted by AWS D1.4. If re-qualification is required, the cost of these qualification tests shall be borne by the Contractor.

1.6 DELIVERY, STORAGE, AND HANDLING

- Bundles of reinforcing bars shall be tagged showing quantity, grade, size, and suitable identification to allow checking, sorting, and placing. Identification of steel shall be maintained after bundles are broken.
 - Bundles of flat sheets and rolls of welded wire reinforcement shall be tagged showing quantity, style designation, width, and length.
- Reinforcing steel shall be stored off the ground in a manner that will prevent bending and be protected from earth, oil, or any other material that might impair bond to concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

- Reinforcing Bars: ASTM A615, Grade 60, deformed, unless otherwise indicated on drawings.

- B. Reinforcing Bars for Welding and Reinforcing Bars Specified as "Special Ductile Quality": ASTM A706 Grade 60, deformed, unless otherwise indicated on drawings. ASTM A615 Grade 60 reinforcement may be used in lieu of ASTM 706 Grade 60 reinforcement if the following conditions apply:
1. The actual yield strength based on mill tests does not exceed the specified yield strength by more than 18,000 psi.
 2. The ratio of the actual ultimate tensile strength to the actual tensile yield strength is not less than 1.25.
 3. Minimum fracture elongation in 8 inches shall be at least 14 percent for bar sizes No. 3 through No. 6, at least 12 percent for bar sizes No. 7 through No. 11, and at least 10 percent for bar sizes No. 14 and No. 18.
 4. Minimum uniform elongation shall be at least 9 percent for bar sizes No. 3 through No. 10, and at least 6 percent for bar sizes No. 11, No. 14, and No. 18.
- C. Column Spirals (where noted): Plain, cold-drawn wire conforming to ASTM A82 or hot-rolled rods for spirals conforming to ASTM A615.
- D. Welded Wire Reinforcement: ASTM A1064; mesh and wire sizes as noted on Structural drawings. When used in slabs, provide flat sheets, not rolls.
- E. Bar Supports: In accordance with CRSI Manual of Standard Practice; types and sizes as required for the conditions of the installation.
1. For exposed to view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are hot- dipped, galvanized, plastic protected, or stainless steel, in accordance with CRSI Class 1 or Class 2 (Types A or B).
 2. Provide precast concrete blocks not less than 4 inches square when supporting reinforcing steel on ground. Precast concrete blocks shall have a compressive strength equal to that of surrounding concrete.
- F. Tie Wire: No. 16-gage minimum, annealed black wire.
- G. Threaded Splices: See General Notes on Structural Drawings.
- H. Headed Bars or Terminators: See General Notes on Structural Drawings.
- I. Steel Stud Assemblies or Studrails: ASTM 1044; Size, length, and assembly configuration as noted on the Structural Drawings.

2.2 FABRICATION

- A. Reinforcement: Bend reinforcement cold. Fabricate and detail to shapes and dimensions shown on drawings in accordance with CRSI Manual of Standard Practice and with fabricating tolerances in accordance with ACI 117.

- B. Welding: Welding or tacking of reinforcing bars is not permitted unless specifically indicated in the Contract Documents. When welding of reinforcement is indicated and required, provide welds in accordance with AWS D1.4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: When concrete is placed, reinforcement shall be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory provided the minimum nominal dimensions, nominal weight, and the minimum average height of deformation of a hand-wire-brushed test specimen are not less than the applicable ASTM specification requirements.
- B. Reinforcement: Place, support, and fasten reinforcement as indicated in the Contract Documents. Do not exceed the placing tolerances specified in ACI 117 before concrete is placed. When necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement or embedded items, submit the resulting arrangement of reinforcement for acceptance.
- C. Cover: Allowable concrete cover for reinforcement is indicated in the project drawings. Tolerances on concrete cover shall meet the requirements of ACI 117.
- D. Tie Wires: After cutting tie wires, turn wires to the inside of section and bend so that concrete placement will not force ends to exposed concrete surfaces.
- E. Welded Wire Reinforcement: Place, support, and fasten welded wire reinforcement as indicated in the Contract Documents and ACI 301. Placement tolerance shall maintain specified cover within $+1/2$ and $-1/4$.
 - 1. Slabs on Grade: Extend welded wire reinforcement to within 2 inches of the concrete edge. Lap edges and ends of reinforcement sheets a minimum of one mesh spacing plus 2 inches, not less than 6 inches. Support welded wire reinforcement during placing of concrete to ensure required position in the slab. Do not place welded wire reinforcement on grade and subsequently raise into position in concrete.
 - 2. Slabs on Steel Deck: Extend welded wire reinforcement to within 2 inches of the concrete edge. Lap edges and ends of reinforcement sheets a minimum of one mesh spacing plus 2 inches, not less than 6 inches. Support welded wire reinforcement during placing of concrete to ensure required position in the slab. Do not place welded wire reinforcement on deck and subsequently raise into position in concrete.
- F. Splicing: Make splices as indicated in the project drawings. Lapped bars shall be placed in contact and securely tied, or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than $1/5$ the required length of lap, and not to exceed 6 inches.

1. Mechanical Splices: Mechanical splices for reinforcement not shown on the project drawings shall be submitted for review and accepted prior to use. Mechanical splices shall be in accordance with the recommendations of the manufacturer of the mechanical splicing device.

G. Reinforcement shall not be field bent or straightened except when specifically permitted.

H. Reinforcement shall not be cut in the field except when specifically permitted.

3.2 DEFECTIVE WORK

A. General: The following reinforcing steel work will be considered defective and shall be removed and replaced by the Contractor at no additional cost to the Owner:

1. Bars with kinks or bends not shown on drawings.
2. Bars injured due to bending or straightening.
3. Bars heated for bending.
4. Reinforcement not placed in accordance with the drawings and/or specifications.

END OF SECTION

SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Features:

- 1. Cast-in-place structural concrete
 - 2. Concrete mix design
 - 3. Concrete placement procedures
 - 4. Concrete finishing
 - 5. Concrete curing
 - 6. Repair of surface defects

- B. Related Sections:

- 1. 013300 – Submittal Procedures
 - 2. 014500 – Structural Testing, Inspection, and Quality Assurance
 - 3. 031000 – Concrete Forming and Accessories
 - 4. 032000 – Concrete Reinforcing
 - 5. 033713 – Shotcrete

1.3 REFERENCE STANDARDS

- A. The latest versions of the publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

- 1. ACI 117 Standard Specification for Tolerances for Concrete
 - 2. ACI 301 Standard Specifications for Structural Concrete,
including other standards referred to in ACI 301, such as ASTM, etc.
 - 3. ACI 305.1 Standard Specification for Hot Weather Concreting
 - 4. ACI 306.1 Standard Specification for Cold Weather Concreting
 - 5. ACI 308.1 Standard Specification for Curing Concrete
 - 6. ASTM C1116 Standard Specification for Fiber-Reinforced
Concrete

1.4 SUBMITTALS

- A. General: Make submittals in accordance with Section 01 33 00, "Submittal Procedures."

- B. Concrete Mix Design Proportions: Submit concrete mixture proportions and characteristics. Submit the concrete mix design to the local building officials where required. Do not begin concrete production until concrete mix designs have been reviewed and approved. Mix designs shall include proportions of all ingredients, including admixtures added at time of batching or at job site. Include the following:
1. Specify the locations for each mix design.
 2. Specify the method used to determine proposed concrete mix design. Include field test records or trial mix test data used to establish the average compressive strength of the concrete mixture.
 3. For aggregates, submit types, pit or quarry locations, producers' names, gradings, specific gravities, certification, and evidence not more than 90 days old demonstrating compliance with this specification. Aggregate weights shall be based upon saturated surface dry conditions. Include concrete mix gradation of fine and coarse aggregates.
 4. For admixtures, submit types, brand names, producers, manufacturer's technical data, and certification data.
 5. Submit the cement type and certification, fly ash type and certification, water/cementitious materials ratio, and source of water supply.
 6. Submit the slump.
 7. Submit the air content of freshly mixed concrete.
 8. Submit the concrete compressive strength at 7, 28, and 56 days. The 56-day strength is required only when specified in the Concrete Mix Specification Table in the General Notes.
 9. Submit the chloride ion content of concrete.
 10. For fibrous reinforcing, submit the type, fiber length, dosage rate, and dosage procedures.
- C. Curing Methods: Submit written methods, procedures, and products for curing of all concrete.
- D. Repair Methods: Submit the proposed methods of repair, along with repair material specification, manufacturer's data on the proposed patching material, and the proposed preparation and application procedure.
- E. Construction Joints: Submit information for acceptance of proposed location and treatment of construction joints proposed but not indicated on the Construction Documents.
- F. Qualification of Finishers: Submit qualifications of the finishing contractor and the finishers who will perform the Work.
- G. Matching Sample Finish: When required by Contract Documents, submit sample finish.
- H. Exposed-Aggregate Surface: When an exposed-aggregate surface is specified and a chemical retarder is proposed, submit specification and manufacturer's data for the retarder and the proposed method of use.

- I. Records: Retain records of all concrete poured, including exact mix proportions, slumps, test strength, date, time, location of the placement, weather conditions at time of placement, and the source of concrete. Submit copy to Owner's Representative and Building Official.
- J. Bill of Materials: Submit concrete volumes per individual mix design and application as outlined in table below prior to start of construction and at completion of construction based on material delivered to project site.

MIX DESIGN NUMBER	ELEMENT	CONCRETE STRENGTH, F'C (PSI)	UNIQUE MIX CHARACTERISTICS	CONCRETE VOLUME (CY)	GWP (kg CO ₂ eq/ CY)
XXXXXXXX X	MISC CONCRETE, CURBS, SIDEWALKS	3,000	4.5% AIR ENTRAINED		
XXXXXXXX X	SLABS	6,000	NORMAL-WEIGHT		
XXXXXXXX X	COLUMNS	10,000	E= 6,000 KSI		
XXXXXXXX X					

NOTES:

- SUPPLIER TO SUBMIT TABLE USING PROJECT-SPECIFIC INFORMATION.
- SUPPLIER TO REPORT ANY ASSUMPTIONS AND ALLOWANCES INCLUDED IN VOLUMES.

1.5 QUALITY ASSURANCE

- A. The Contractor is responsible for correcting Work that does not conform to the specified requirements, including strength, tolerances, and finishes. The Contractor shall submit the proposed solution for review and approval.
- B. Unless otherwise noted, maintain the allowable tolerances in ACI 117.
- C. Maintain records verifying materials used are of the specified and accepted types and sizes and are in conformance with the Contract Documents.
- D. Special Inspection and Testing: Concrete work is subject to special inspection and testing as specified; notify the Testing Agency at least 48 hours before inspection is required.
- E. Single Source Responsibility: Provide materials for concrete work made or produced from a single source of supply; no mixing of brands or types of cement will be allowed; no substitution of aggregate type or size from those approved will be permitted.
- F. Concrete Contractor Qualifications: An experienced concrete contractor who has completed concrete Work 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.

- G. Concrete Producer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C94. Producer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Cementitious Materials: Store cementitious materials in dry, weather- tight buildings, bins, or silos that will exclude contaminants.
- B. Aggregates: Store and handle aggregate in a manner that will avoid segregation and prevent contamination with other materials or other sizes of aggregates. Store aggregates to drain freely. Do not use aggregates that contain frozen lumps.
- C. Admixtures: Protect stored admixtures against contamination, evaporation, or damage. Protect liquid admixtures from freezing and from temperature changes that will adversely affect their characteristics. Store and handle products in a manner to retain original quality. Do not use products stored beyond the manufacturer's recommended shelf life.
- D. Delivery of Materials: Deliver site applied materials, such as joint and curing materials, in original factory packaging and unopened containers and protect from damage and contamination.
- E. Place concrete within the time limits specified. Concrete shall possess the specified characteristics in the freshly mixed state at the point of placing.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cementitious Materials
 - 1. Portland Cement: Cements shall conform to either portland cement standard ASTM C150, Type I or Type II. ASTM C150 Type III cement may be used for cold weather construction. For architectural concrete, use one brand of cement throughout project, unless otherwise acceptable to the Architect.
 - 2. Blended Hydraulic Cement: Cements shall conform to standards ASTM C595, Type IL, IS, IP, or IT.
 - 3. Hydraulic Cement: Cements shall conform to standard ASTM C1157.
 - 4. Alternative Cements: Alternative cements not conforming to the standards above will be subject to Structural Engineer's approval. Approval will be based on upon test data documenting the proposed concrete mixture made with the alternative cement meets the performance requirements for the application including structural, fire, and durability.

5. Fly Ash: Pozzolanic mineral admixture conforming to ASTM C618. Maximum loss on ignition to be 6 percent. Use fly ash from a single source for the whole project.
 6. Slag: Ground-granulated blast-furnace slag conforming to ASTM C989.
 7. Silica Fume: Silica fume conforming to ASTM C1240.
 8. Use cementitious materials of same brand and type and from same manufacturing plant as cementitious materials used in the concrete represented by the submitted field test records or used in the trial mixtures.
- B. Aggregate: Aggregates and aggregate grading requirements shall conform to ASTM C33 or C330. Aggregates shall be free from any substance that may be deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of the concrete. Aggregates used in concrete shall be obtained from same sources and have the same size ranges as the aggregates used in the concrete represented by submitted historical data or used in trial mixtures.
- C. Admixtures: The use of admixtures shall be the responsibility of the Contractor. When more than one admixture is used in the mix, furnish satisfactory evidence to the Architect that the admixtures to be used are compatible in combination with the cement and aggregates. Provide only one brand of each type of admixture. Admixtures shall be free of calcium chloride and thiocyanate (not more than 0.05% chloride ions). The following types of admixtures are approved:
1. Air-Entrainment Admixture: Conforming to ASTM C260.
 2. Water-Reducing Admixture (Low Range): Conforming to ASTM C494, Type A.
 3. Water-Reducing Admixture (High Range): Conforming to ASTM C494, Type F.
 4. Retarding Admixture: Conforming to ASTM C494, Type B.
 5. Accelerating Admixture: Conforming to ASTM C494, Type C.
 6. Shrinkage Reducing Admixture: Conforming to ASTM C494, Type S.
 7. Corrosion Inhibiting Admixture: Conforming to ASTM C494, Type S. Calcium Nitrite based with solids content of 30 +/- 2%. Dosage rate varies between 2 and 4 gallons/cubic yards. Contact manufacturer's representative for corrosion-protection guidance based on chloride exposure level.
- D. Water: Water shall be in conformance with ASTM C1602.

2.2 RELATED MATERIALS

- A. Dissipating Resin Curing Materials: Liquid type membrane-forming curing compound complying with ASTM C309, Type I. Curing compound must be of a type that does not inhibit subsequent moist curing operations. The film shall chemically break down in a 6- to 8-week period and shall not affect adhesion of coverings or membranes.

- B. Cure and Seal Combination Materials (Exposed Interior Concrete Slabs, including Garage Slabs): Use curing and sealing compounds that conform to ASTM C309 (Types 1 and 1D, Class B) or ASTM C1315.
- C. Moisture Retaining Cover: Use waterproof sheet materials that conform to ASTM C171.
- D. High Density Insulation Fillers: Extruded polystyrene foam insulation complying with ASTM D6817 as noted in the Construction Documents. Where no type is indicated use ASTM D6817 EPS22.
- E. Commercial Bonding Grout and Repair Materials: Use products in accordance with manufacturer's recommendations. Products include, but are not limited to, the following:
 - 1. Portland-cement mortar modified with a latex acrylic, non-re-emulsifiable bonding agent conforming to ASTM C1059 Type II.
 - 2. Epoxy mortars and epoxy compounds that are moisture-insensitive during application and after curing and that embody an epoxy binder conforming to ASTM C881. The type, grade, and class shall be appropriate for the application as specified in ASTM C881.
 - 3. Shrinkage-compensating or nonshrink Portland cement grout conforming to ASTM C1107.
 - 4. Packaged, dry concrete repair materials conforming to ASTM C928.

2.3 PROPORTIONING AND DESIGN REQUIREMENTS OF CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete by Field Experience Method or, if not available, by Laboratory Trial Batch Methods as specified in ACI 301. Mix proportions shall produce consistent and workable concrete that can be worked readily into forms and around reinforcement without segregation or excessive bleeding.
 - 1. Field Experience Method: If field test data is available, in accordance with ACI 301, submit for acceptance the mixture proportions along with the field test data.
 - 2. Trial Batch Method: Use an independent, qualified Testing Facility for preparing and reporting proposed mix designs. All expenses connected with such testing and submittals shall be borne by the Contractor.
- B. Concrete Mixes: Provide concrete mixes conforming to the requirements as indicated in the Structural Drawing General Notes.
 - 1. Strength Requirements: Compressive strength requirements are indicated on drawings and are based on cylinder tests at date of acceptance or test age indicated on the Structural Drawings. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type III Portland cement.

2. Cement Content for Slabs: Not less than those indicated in ACI 301.
 3. Water/Cementitious Material Ratio: Not to exceed limits indicated on the Structural Drawings.
 4. Air Entrainment: Use air-entraining admixture in exterior exposed concrete as indicated on the Structural Drawings.
 5. Slump: The Contractor shall determine slump. Each concrete mix submitted shall have the slump specified. Slump tolerances shall meet the requirements of ACI 117.
 6. Admixtures: Concrete may contain admixtures, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete. When admixtures are specified or required for workability for particular parts of the Work, use the types specified.
 7. Chloride Ion: Maximum water soluble chloride ion concentrations in hardened concrete at ages 28 to 42 days contributed from the ingredients, including water, aggregates, cementitious materials and admixtures, shall not exceed a maximum, by weight of cement, of 0.06% for prestressed concrete and 0.30% for other concrete as tested in accordance with ASTM C1218.
 8. Alternative Concrete Technologies: Alternative processes for mixing of concrete, such as carbon dioxide mineralization, are acceptable provided any such process is included in the laboratory trial batch and corresponding concrete mix submittal, subject to the engineer's approval.
 9. Lightweight Concrete Density: Where lightweight concrete is specified, proportion lightweight concrete mixtures to meet equilibrium density specified in Contract Documents. Unless noted otherwise, calculate the approximate equilibrium density of mixture from measured or calculated oven-dry density in accordance with ASTM C567. Correlate equilibrium density with fresh density of concrete. Fresh density will be used as basis for acceptance during construction.
- C. 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 the Owner. New field data, data from new trial mixtures, or evidence that indicates that the change will not adversely affect the relevant properties of the concrete shall be submitted for acceptance before use.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Do not place concrete until the Architect approves all required submittals.

- B. Remove snow, ice, frost, water, and other foreign materials from form surfaces, reinforcement, and embedded items against which concrete will be placed.
- C. Place concrete on properly prepared and unfrozen sub-grade or forms and only in dewatered excavations and forms.
- D. Do not allow mud or foreign materials into the concrete during placement operations.
- E. When the ambient temperature necessitates the use of cold or hot weather concreting, make provisions in advance of concrete placement.
- F. Do not begin placing concrete when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing.
- G. Do not begin placing concrete while rain, sleet, or snow is falling unless adequate protection is provided. Do not allow rainwater to increase mixing water or to damage the surface of the concrete.

3.2 JOINTS

- A. Construction Joints: Locate construction joints as indicated on the structural drawings or as approved by the Architect. Remove laitance and thoroughly clean and dampen construction joints prior to placement of fresh concrete.
- B. Bonded Construction Joints: Coat concrete joined with new concrete, including topping, with a concrete bonding compound. Mix and apply in strict accordance with manufacturer's recommendations for the conditions of the application. Concrete surfaces to which other concrete is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete; remove all laitance and loose particles.
- C. Control Joints in Slabs-on-Ground: Construct control joints in slabs- on-ground to form panels of patterns as approved. Use inserts 1/4 inch wide by depth indicated on the drawings. Where saw-cut joints are required or permitted, start cutting as soon as concrete has hardened sufficiently to prevent dislodgment of aggregates. Saw a continuous slot to the depth indicated on the drawings. Complete sawing within the timeframe indicated on the drawings. The aspect ratio of the slab panels should be a maximum of 1.5:1. "L" and "T" shaped panels should be avoided. If an alternative method, timing, or depth is proposed for saw cutting, submit detailed procedure plans for review and acceptance.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by,

cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

1. Embedded items include, but are not limited to, expansion joints, joint fillers, waterstops, anchor bolts, embedded plates, dovetail anchor slots, etc.
2. Items shall be free of oil, loose scale, rust, etc.
3. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent the entry of concrete into the voids.
4. Do not embed aluminum in concrete, except where the aluminum is protected from direct contact from the concrete.

3.4 INSTALLATION OF HIGH DENSITY INSULATION FILLER

- A. Insulation Fillers: Lay high density insulation in areas as indicated on drawings. Use boards of maximum thickness to achieve full insulation depth as indicated. If required, apply adhesive to layers of insulation to prevent movement during concrete placement. After boards have been installed, protect until concrete topping is prepared and placed.

3.5 CONCRETE DELIVERY

- A. Ready-Mix Concrete: Comply with requirements of ASTM C94 and as herein specified.

1. Elapsed time from start of batching at plant to completed discharge at job site shall not exceed 90 minutes or more than 300 revolutions, whichever comes first after introducing mixing water.
2. The concrete temperature shall be monitored in the truck. A rise in temperature of 5°F within 10 minutes or less indicates concrete setting has started before discharge and the load shall be rejected.
3. Ready-Mix Concrete: Provide certificate signed by authorized official of supplier with each load of concrete, stating the following:
 - a. Time truck left plant
 - b. Mix of concrete
 - c. Amount of water and cement in mix
 - d. Amount and type of admixtures
 - e. Time truck is unloaded at site
 - f. Additional water amount allowed at the project site
4. A truck without batch tickets will be rejected.

- B. Control of Mixing Water: Water may be added once to increase the slump of the concrete within the first 15 minutes after the truck arrives at the job-site, provided the following requirements are adhered to:

1. The specified slump and maximum allowable water/cement ratio is not exceeded.
 2. The Independent Testing Agency is present to monitor the amount of water added to compare with the amount of water added at the plant. Testing Agency shall keep written record of the amount of water added at the job-site to each truckload delivered.
 3. The drum shall be turned an additional 30 revolutions, or more if necessary, until the added water is uniformly mixed into the concrete.
 4. Water shall not be added to the batch after the taking of test cylinders, unless new test cylinders are taken at the expense of the Contractor.
 5. Do not add water to concrete after adding high-range water- reducing admixtures to mix unless approved by both the ready-mix producer and the admixture producer.
- C. Admixtures: Add admixtures within an accuracy of 3%. Where two or more admixtures are used in the same batch, they shall be added separately and must be compatible. Approved admixtures must be added at the appropriate time in strict compliance with manufacturer's directions. Concrete that shows evidence of total collapse or segregation caused by the use of admixtures shall be removed from the site.
- D. Lightweight Concrete Density: Acceptance of lightweight concrete will be based on fresh density measured in accordance with ASTM C138. Required fresh density is based on specified equilibrium density and correlated with fresh density. Unless approved otherwise, do not use concrete for which fresh density varies by more than 4 pounds per cubic foot from the required fresh density.

3.6 CONCRETE PLACEMENT

- A. Pre-Placement Inspection: Before concrete placement operation begins, perform the following procedures:
1. Inspect and complete formwork installation and all reinforcing, and embed items. Notify other crafts to permit installation of their work.
 2. Ensure that the reinforcing will be maintained in the proper position during concrete placement operations.
 3. Moisten wood forms immediately before placing concrete where form coatings are not used.
 4. At topping slabs, thoroughly saturate base slab just prior to placing topping, but do not leave pools of water.
 5. Verify all dimensions and elevations.
- B. Conveying: Methods of conveying concrete is the responsibility of the Contractor. Convey concrete from mixer to the place of final deposit rapidly by methods that prevent segregation or loss of ingredients and that will ensure the required quality of concrete. Do not use aluminum pipes or chutes. Use acceptable conveying equipment of a size and

design that will prevent cold joints from occurring. Clean conveying equipment before each placement.

1. Provide runways or other means for wheeled equipment to convey concrete to deposit points. Do not run wheeled equipment used to deposit concrete over reinforcement; do not support runways on reinforcement.
 2. Belt Conveyors: Use belt conveyors that are horizontal or at a slope that will not cause excessive segregation or loss of ingredients. Protect concrete to minimize drying and effects of temperature rise. Use an acceptable discharge baffle or hopper at the discharge end to prevent segregation. Do not allow mortar to adhere to the return length of the belt.
 3. Chutes: Use metal or metal-lined chutes having rounded bottoms and a slope between 1:2 and 1:3 (vertical:horizontal). Chutes more than 20 feet long and those not meeting slope requirements may be used, provided they discharge into a hopper prior to distributing into the forms.
 4. Pumping or Pneumatic Conveying: Use pumping conveying equipment that permits placement rates that avoid cold joints and prevent segregation in discharge of pumped concrete. In addition:
 - a. Pipeline shall be steel pipe or heavy-duty flexible hose.
 - b. Inside diameter of the pipe shall be at least five times the maximum size of the coarse aggregate.
 - c. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer.
 - d. Provide continuous supply of concrete to the pump.
 - e. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place.
 5. Cleaning: Do not discharge rinse water into forms or areas to receive concrete.
- C. Depositing: Deposit concrete continuously in one layer, or in multiple layers if the fresh concrete is deposited on in-place concrete that is still plastic. Do not deposit fresh concrete on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joint as specified. Deposit concrete as near to its final location as practicable to avoid segregation. In addition:
1. Do not subject concrete to procedures that will cause segregation.
 2. Do not use concrete that has surface-dried or partially hardened or that contains foreign material.
 3. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs.
- D. Consolidating: Consolidate concrete by vibration. Thoroughly work concrete around reinforcement and embedded items and into corners of

forms, eliminating air and stone pockets that may cause honeycombing, pitting, or planes of weakness.

1. Workers shall be experienced in use of the vibrators.
 2. Vibrators shall have a frequency of not less than 8,000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mix being placed. A spare vibrator shall be kept at the job site during all concrete placing operations.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniform spacing over the area of placement; distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just vibrated area by a few inches. Do not place vibrators within 2-1/2 inches of form face.
 4. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set; if there is a delay of more than 15 minutes, vibrate previous lift prior to placing the new concrete. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix. Withdraw vibrators slowly.
 5. Consolidation of slabs shall be obtained with vibrating screeds, rolling pipe screeds, or internal vibrators.
- E. Re-tamping of concrete that has taken its initial set is not allowed.
- F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as specified herein.
1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators.
- G. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305.1 and as specified herein. Loss of slump, flash set, or cold joints due to temperature of concrete as placed are not acceptable.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 95°F. Mixing water may be chilled, or

chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.

2. When temperature of steel reinforcement, embedments, or forms is greater than 120°F, fog steel reinforcement, embedments, and forms with water immediately before placing concrete. Remove standing water before placing concrete.
3. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, if approved by the Architect.

3.7 FINISHES FOR FORMED SURFACES

- A. General: After removal of forms, give each formed surface one or more of the finishes described below. When Contract Documents do not specify a finish, finish surfaces as required by Unspecified Finishes.
- B. When the finish is required by the Contract Documents to match a sample panel furnished by the Contractor, reproduce the sample finish on an area at least 100 square feet in a location designated by the Architect. Obtain acceptance before proceeding with that finish in the specified locations.
- C. As-Cast Finishes: Coordinate finishes of all "as-cast" concrete finishes with construction of formwork. Produce as-cast form finishes in accordance with the following requirements:
 1. Rough-Form Finish:
 - a. Patch voids larger than 3/4 in. wide or 1/2 in. deep.
 - b. Remove projections larger than 1/2 in.
 - c. Tie holes need not be patched.
 - d. Surface tolerance Class C as specified in ACI 117.
 2. Smooth-Form Finish:
 - a. Patch voids larger than 3/4 in. wide or 1/2 in. deep.
 - b. Remove projections larger than 1/4 in.
 - c. Patch tie holes.
 - d. Surface tolerance Class B as specified in ACI 117.
 3. Architectural Finish: Patch tie holes and defects, and remove fins. Produce architectural finishes as specified in the Contract Documents.
- D. Rubbed Finishes: Remove forms as early as permitted, and produce one of the following finishes on concrete specified to have a smooth form finish:
 1. Smooth-Rubbed Finish: Patch tie holes and defects, and remove fins. Produce finish on newly hardened concrete no later than

- the day following formwork removal. Wet the surface and rub it with carborundum brick or other abrasive until uniform color and texture are produced. Use no cement grout other than the cement paste drawn from the concrete itself by the rubbing process.
2. Grout-Cleaned Finish: Patch tie holes and defects, and remove fins. Begin cleaning operations after contiguous surfaces to be cleaned are completed and accessible. Do not clean surfaces as work progresses. Wet the surface and apply grout consisting of 1 part Portland cement and 1-1/2 parts fine sand with enough water to produce the consistency of thick paint. Add white cement as needed to match color of surrounding concrete. Scrub grout into voids, and remove excess grout. When grout whitens, rub the surface. Keep the surface damp for 36 hours afterward.
 3. Cork-Floated Finish: Patch tie holes and defects, and remove fins. Wet the surface and apply stiff grout of 1 part Portland cement and 1 part fine sand, filling voids. Add white cement as needed to match color of surrounding concrete. Use enough water to produce a stiff consistency. Compress grout into voids by grinding the surface with a slow-speed grinder. Produce the final finish with cork float, using a swirling motion.
- E. Sandblast Finish: After removal of forms and while concrete is still "green," apply a light abrasive blast finish to exposed-to-view surfaces to match approved sample. Perform abrasive blasting in a continuous operation, utilizing same work crew to maintain continuity of finish on each surface. Use wet sandblasting operations. Use same type and grading of abrasives as that used on approved sample. Continually wash off abraded mortar from sandblasted areas to prevent staining.
- F. Unspecified Finishes: When a specific finish is not specified in Contract Documents for a concrete surface, apply the following finishes:
1. Rough-form finish on concrete surfaces not exposed to public view.
 2. Smooth-form finish on concrete surfaces exposed to public view.
- G. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent surfaces, unless otherwise indicated.

3.8 FINISHES FOR UNFORMED SURFACES

- A. General: Finish slab surfaces in accordance with one of the finishes noted below, as designated in the Contract Documents. Finish all joints and edges with proper tools as approved.
- B. Placement: Place concrete at a rate that allows spreading, straightedging, and darbying or bull floating before bleed water appears. Screed all slabs, topping fills to true levels and slopes. Work surfaces as required to produce specified finish. Do no finishing

in areas where water has accumulated; drain and re-screed. In no case use a sprinkling of cement and sand to absorb moisture.

- C. Tolerances: Measure floor slabs for suspended floors and slabs-on-grade to verify compliance with the tolerance requirements of ASTM E 1155 and ACI 117. Measure floor finish tolerances within 72 hours after slab finishing and before removal of supporting formwork or shoring.
- D. Scratch Finish: Place, consolidate, strike off, and level concrete, eliminating high spots and low spots. Roughen the surface with stiff brushes or rakes before the final set. Produce a finish that will meet Moderately flat (Ff flatness = 25) requirements of ACI 117.
- E. Float Finish: Place, consolidate, strike off, and level concrete, eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Produce a finish that will meet Moderately flat (Ff flatness = 25) requirements of ACI 117, then refloat the slab immediately to a uniform texture.
- F. Light Steel Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until all "shine" has disappeared from surface; no final troweling is required. Tolerance for concrete floors shall be Moderately flat (Ff flatness = 25) in accordance with ACI 117.
- G. Full Steel Trowel Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled. Finished surface shall be free of trowel marks, uniform in texture and appearance. Tolerance for concrete floors shall be Moderately flat (Ff flatness = 25) in accordance with ACI 117.
- H. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface. Degree of texture shall be as approved by the Architect. Tolerance for concrete floors shall be Moderately flat (Ff flatness = 25) in accordance with ACI 117.
- I. Raked Finish: Immediately after concrete has received a floated finish, draw closely spaced rake across surface with ribs perpendicular to traffic flow. Notify Architect at time of finishing so that they may be present to approve the final degree of texture required. Tolerance for concrete floors shall be Moderately flat (Ff flatness = 25) tolerance in accordance with ACI 117.
- J. Dry-Shake Finish: Blend metallic or mineral aggregate specified in Contract Documents with Portland cement in the proportions recommended by the aggregate manufacturer, or use bagged, premixed material

specified in Contract Documents as recommended by the aggregate manufacturer.

1. Float-finish the concrete surface.
 2. Apply approximately 2/3 of the blended material required for coverage to the surface by a method that ensures even coverage without segregation. Float-finish the surface after application of the first dry-shake.
 3. Apply the remaining dry-shake material at right angles to the first application and in locations necessary to provide the specified minimum thickness. Begin final floating and finishing immediately after application of the dry-shake.
 4. After selected material is embedded by the two floatings, complete operation with a broomed, floated, or troweled finish, as specified in the Contract Documents.
- K. Exposed-Aggregate Finish: Immediately after surface of the concrete has been leveled to meet the Moderately flat (Ff flatness = 25) tolerance requirements of ACI 117 and the bleed water sheen has disappeared, spread aggregate of the color and size specified in Contract Documents uniformly over the surface to provide complete coverage to a depth of one stone.
1. Tamp the aggregate lightly to embed aggregate in the surface. Float the surface until the embedded stone is fully coated with mortar and the surface has been finished to meet the Moderately flat (Ff flatness = 25) tolerance requirements of ACI 117.
 2. After the matrix has hardened sufficiently to prevent dislodgment of the aggregate, apply water carefully and brush the surface with a fine-bristled brush to expose the aggregate without dislodging it.
 3. An acceptable chemical retarder sprayed on freshly floated concrete surface may be used to extend the working time for the exposure of aggregate.
- L. Non-specified Finish: When the type of finish is not specified in Contract Documents, use one of the following appropriate finishes and accompanying tolerances.
1. Scratched Finish: For surfaces intended to receive bonded cementitious mixtures.
 2. Floated Finish: For walks, drives, steps, ramps, and for surfaces intended to receive waterproofing, roofing, insulation, or sand-bed terrazzo.
 3. Full Steel Troweled Finish: For floors intended as walking surfaces, floors in manufacturing, storage, and warehousing areas, or for reception of floor coverings.

3.9 CONCRETE CURING AND PROTECTION

- A. General: Cure concrete in accordance with the Curing Methods noted below for a minimum of 7 days after placement. Cure high-early strength

concrete for a minimum of 3 days after placement. Alternatively, moisture retention measures may be terminated when any of the following criteria are met:

1. Tests made on at least two cylinders kept adjacent to the structure and cured by the same methods as the structure indicate 70% of f'_c , as determined in accordance with ASTM C39, has been attained.
 2. The compressive strength of laboratory-cured cylinders, representative of the in-place concrete, exceeds 85% f'_c , provided the temperature of the in-place concrete has been maintained at 50°F or higher during curing.
 3. Strength of concrete reaches f'_c as determined by accepted nondestructive test methods.
- B. Additional Curing Periods: When the 7-day compression test cylinders, representative of parts of a structure already placed, indicate that the 28-day strengths may be less than 85 percent of the design strengths, give those parts of the structure additional curing.
- C. Protection: Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
1. Protect concrete during the curing period such that the concrete temperature does not fall below requirements of ACI 306.1. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and to ensure the necessary strength development for structural safety.
 2. Maintain protection in such a manner that the maximum decrease in temperature measured at the surface of the concrete in a 24-hour period shall not exceed the following:
 - a. 50°F for sections less than 12 inches in the least dimension.
 - b. 40°F for sections from 12 to 36 inches in the least dimension.
 - c. 30°F for sections 36 to 72 inches in the least dimension.
 - d. 20°F for sections greater than 72 inches in the least dimension.
 3. Measure and record concrete temperature using a method acceptable to the Architect/Engineer. When the surface temperature of the concrete is within 20°F of the ambient temperature, protection measures may be removed.
- D. Curing Unformed Concrete Surfaces: Apply one of the Curing Methods after completion of placement and finishing of concrete surfaces not in contact with forms.

- E. Curing Formed Concrete Surfaces: Keep absorbent wood forms wet until they are removed. After formwork removal, cure concrete by one the Curing Methods.
- F. Curing Methods: After placing and finishing, use one or more of the following methods to preserve moisture in concrete. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing, or as soon as marring of the concrete will not occur. When one of the curing procedures is used initially, the curing procedure may be replaced by one of the other procedures when concrete is 1 day old, provided the concrete is not permitted to become surface- dry at any time. Avoid rapid drying at end of final curing period.
 - 1. Ponding, continuous fogging, or continuous sprinkling.
 - 2. Application of mats or fabric kept continuously wet.
 - 3. Continuous application of steam (under 150°F).
 - 4. Application of sheet materials conforming to ASTM C171.
 - 5. Application of a curing compound conforming to ASTM C309 or C1315.
 - a. Apply the compound in accordance with manufacturer's recommendation as soon as water sheen has disappeared from the concrete surface and after finishing operations.
 - b. For rough surfaces, apply curing compound in two applications at right angles to each other.
 - c. Do not use curing compound on any surface where concrete or other material will be bonded unless the curing compound will not prevent bond or unless measures are to be taken to completely remove the curing compound from areas to receive bonded applications.
 - d. Curing compound may be used on concrete that is to receive resilient flooring, carpet, sand cushion terrazzo, and wood flooring, unless otherwise required by finish treatment manufacturer. Provide written certification from the finish floor treatment manufacturer as previously specified.
 - e. The Contractor shall be responsible for removing any traces of the dissipating curing compound that remains on the substrate prior to applying subsequent floor finish. This shall include, but is not limited to, removing the curing compound using power scrubbers and industrial strength detergents and using fresh water to remove the detergents. Comply with any additional instructions and recommendations of the manufacturer whose products are to be applied directly over concrete slab.
 - 6. Application of other accepted moisture-retaining method.

3.10 CONCRETE SURFACE REPAIRS

- A. General: All surface defects shall be reported to the Architect. Remove and replace concrete having defective surfaces if defects cannot be repaired to the satisfaction of the Architect.

- B. Repair of Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins, stains, and other discolorations that cannot be removed by cleaning.
 - 1. Repair concealed formed surfaces that contain defects that affect the durability of concrete.
 - 2. Repair tie holes and surface defects immediately after formwork removal. Where the concrete surface will be textured by sandblasting or bush-hammering, repair surface defects before texturing.
- C. Repair of Unformed Surfaces: Surface defects include crazing, cracks in excess of 0.01 inch wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
 - 1. Repair finished unformed surfaces that contain defects that affect durability of concrete.
 - 2. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope.
 - 3. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days. Depth or removal shall not exceed 1/4 inch without scanning the affected area to verify required concrete cover will be maintained over reinforcing, post-tensioning tendons, or other embedment.
 - 4. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Architect.
- D. Repair of Tie Holes: Plug tie holes except where stainless steel ties, non-corroding ties, or acceptably coated ties are used. When Portland cement patching mortar is used for plugging, clean and dampen tie holes before applying the mortar. When other materials are used, apply them in accordance with manufacturer's recommendations.
- E. Repair of Surface Defects: Submit Method Statement of Repair that includes proposed repair product, surface preparation procedures, inspection schedule and application procedures prior to the commencement of work.
 - 1. Surface Preparation: Unless otherwise directed by the repair product's manufacturer:
 - a. Outline honeycombed or otherwise defective concrete with a 1/2- to 3/4-inch-deep saw cut and remove such concrete down to sound concrete.

- b. When chipping is necessary, leave chipped edges perpendicular to the surface or slightly undercut. Do not feather edges.
 - c. Dampen the area to be patched, plus 6 inches around the patch area perimeter.
 - d. Prepare bonding grout and thoroughly brush grout into the surface.
 - e. When the bond coat begins to lose water sheen, apply patching mortar and thoroughly consolidate mortar into place. Strike off mortar, leaving the patch slightly higher than the surrounding surface to permit initial shrinkage.
 - f. Leave the patch undisturbed for 1 hour before finishing. Keep the patch damp for 7 days.
 2. Partially Exposed Reinforcement: The surface of partially exposed reinforcement where exposed less than and equal to 3/8- inch shall be cleaned of detritus material. Where reinforcement is exposed more than 3/8 inch, concrete shall be removed around the entire circumference of the reinforcement for a minimum of 1/4 inch plus the maximum aggregate size and cleaned of detritus material.
- F. Removal of Stains: Remove stains, rust, efflorescence, and surface deposits considered objectionable by the Architect by acceptable methods.
- G. Site-Mixed Repair Materials:
 1. Bonding Grout: Mix approximately 1 part cement and 1 part fine sand with water to the consistency of thick cream.
 2. Repair Mortar: Mix repair mortar using the same materials as concrete to be patched with no coarse aggregate. Do not use more than 1 part cement to 2-1/2 parts sand by damp loose volume.
 - a. For repairs in exposed concrete, make a trial batch and check color compatibility of repair material with surrounding concrete. Blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding.
 - b. Use repair mortar at a stiff consistency with no more mixing water than is necessary for handling and placing. Mix repair mortar and manipulate the mortar frequently with a trowel without adding water.
- H. Commercial Repair Products: Acceptable commercial repair products other than site-mixed repair materials may be used for repair, as specified in Part 2. Use repair products in accordance with manufacturer's recommendations.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations lightly rounded.
- B. Equipment Bases and Foundations: Form bases for the mounting of equipment shown on drawings. Coordinate sizes and requirements for bases with trade requiring same; make bases a minimum of 4 inches high, unless otherwise noted on drawings, and finish to match adjacent floor finish. Set anchor bolts for machines and equipment to correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
- C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Screed, tamp, and finish concrete surfaces with light broom finish.

END OF SECTION

SECTION 042000 – UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Features: Materials and construction for concrete unit masonry assemblies.
- B. Related Sections:
 - 1. 013300 – Submittal Procedures
 - 2. 014500 – Structural Testing, Inspection, and Quality Assurance
 - 3. 032000 – Concrete Reinforcement
 - 4. 033000 – Cast-in-Place Concrete
 - 5. 051200 – Structural Steel Framing
 - 6. 071900 – Water Repellents
 - 7. 076200 – Sheet Metal Flashing and Trim
 - 8. 079200 – Joint Sealants

1.3 REFERENCE STANDARDS

- A. The latest versions at the time of the bid document release of the publications listed below form a part of this specification; comply with the provisions of these publications except as otherwise shown or specified.
- B. The Masonry Society (TMS):
 - 1. TMS 402: Building Code Requirements for Masonry Structures
 - 2. TMS 602: Specifications for Masonry Structures
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rods, 60,000 psi Tensile Strength
 - 2. ASTM A615: Standard Specifications for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 3. ASTM A1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 4. ASTM C90: Standard Specification for Load Bearing Concrete Masonry Units
 - 5. ASTM C140: Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
 - 6. ASTM C144: Standard Specification for Aggregate for Masonry Mortar
 - 7. ASTM C150: Standard Specification for Portland Cement

8. ASTM C207: Standard Specification for Hydrated Lime for Masonry Purposes
9. ASTM C270: Standard Specification for Mortar for Unit Masonry
10. ASTM C404: Standard Specification for Aggregates for Masonry Grout
11. ASTM C476: Standard Specification for Grout for Masonry
12. ASTM C595: Standard Specification for Blended Hydraulic Cements
13. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
14. ASTM C780: Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
15. ASTM C989: Standard Specification for Slag Cement for Use in Concrete and Mortars
16. ASTM C1019: Standard Test Method for Sampling and Testing Grout
17. ASTM C1314: Standard Test Method for Compressive Strength of Masonry Prisms
18. ASTM C1611: Standard Test Method for Slump Flow of Self- Consolidating Concrete
19. ASTM F1554: Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

- D. National Concrete Masonry Association (NCMA): NCMA TEK NOTES.
<http://www.ncma.org>

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Section 01 33 00, "Submittal Procedures."
- B. Product data for each different masonry unit, accessory, and other manufactured product indicated.
- C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, and reinforcing layout. Wall elevations shall be provided indicating control joint locations, connections, wall openings including MEP penetrations larger than 16 inches, embedded items, and relationship with adjacent construction. Reinforcement for bearing and shear walls shown on the structural drawings to be shown on 1/8-inch scale wall elevations.
- D. Samples for verification purposes of the following:
 1. Full-size units for each different exposed masonry unit required showing full range of exposed color, texture, and dimensions to be expected in completed construction.
 2. Accessories embedded in the masonry.
- E. Material certificates for the following signed by manufacturer and Contractor certifying that each material complies with requirements.

1. Each different cement product required for mortar and grout including name of manufacturer, brand, type, and weight slips at time of delivery.
 2. Each type and size of joint reinforcement.
 3. Each type and size of anchors, ties, fasteners, and metal accessories.
 4. Self-consolidating grout.
- F. Mix designs and material test reports from a qualified independent testing laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:
1. One of the following for each mortar mix:
 - a. Mix designs indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C270, or
 - b. Mix designs and mortar tests performed in accordance with the property specification of ASTM C270.
 2. One of the following for each grout mix:
 - a. Mix designs indicating type and proportions of the ingredients according to the proportion requirements of ASTM C476, or
 - b. Mix designs and grout strength test performed in accordance with ASTM C476, or
 - c. Compressive strength tests performed in accordance with ASTM C1019, and slump flow and visual stability index (VSI) as determined by ASTM C1611/C1611M.
 3. Masonry units complying with property requirements of ASTM C90.
- G. Cold-weather construction procedures evidencing compliance with requirements specified in Section 1.8C of TMS 602.
- H. Hot-weather construction procedures evidencing compliance with requirements specified in Section 1.8D of TMS 602.
- I. Qualification data for firms and persons specified in Section 1.6 of TMS 602, to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, telephone numbers, names of Architects and Owners, and other information specified.
- J. Bracing drawings and calculations where required by Section 3.3E of TMS 602, sealed by an engineer licensed to perform the work in the jurisdiction where the project is being constructed, shall be submitted for record purposes.

- K. Results from tests and inspections performed by Owner's representatives will be reported promptly and in writing to Architect and Contractor.
- L. Environmental Product Declarations (EPDs): For masonry units, grout, and mortar, submit product-specific Type III EPDs conforming to ISO 14025 and ISO 21930 including Life Cycle Assessment Modules A1-A3 which at a minimum must include Global Warming Potential (GWP). Submit EPDs for a minimum of 90 percent by volume of material used in the project.
- M. Recycled Content: For LEED v4 documentation and points, submit documentation of the materials' percent recycled content compared to totals, measured by weight or volume.
- N. Bill of Materials: Submit total masonry block weight, grout volume, and mortar volume prior to start of construction and at completion of construction based on material delivered to project site. Report any assumptions and allowances included in weights and volumes.

1.5 QUALITY ASSURANCE

- A. Comply with governing codes and regulations.
- B. Preconstruction Testing: A qualified independent testing laboratory shall be engaged to perform the following preconstruction testing indicated as well as other inspecting and testing services in accordance with Section 01 45 00, "Structural Testing, Inspection, and Quality Assurance" or indicated herein for source and field quality control:
 - 1. Concrete Masonry Unit Tests: For each different concrete masonry unit indicated, units will be tested for strength, absorption, and moisture content per ASTM C140.
 - 2. Mortar properties will be tested per property specification of ASTM C270.
 - 3. Mortar composition and properties will be evaluated per ASTM C780.
 - 4. Grout properties will be tested per property specification of ASTM C476.
 - 5. Grout compressive strength will be tested per ASTM C1019.
- C. Single-Source Responsibility for Masonry Units: Obtain masonry units of uniform texture, color, and blend from a single manufacturer. In exposed work, do not use masonry units with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in the finished work.
- D. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for masonry, from a single manufacturer for each cementitious component.
- E. Mock-Up: The Contractor shall identify an area that shall serve as the masonry mock-up. The mock-up shall be used to determine and establish

the quality of workmanship and mix of masonry for appearance. Further masonry work shall not proceed without approval of the mock-up.

1. Mock-up area shall be no less than 250 square feet in area.
2. Build mockups in accordance with the drawings.
3. Revise or rebuild mockups as required for conformance to details, documents, and intended aesthetic effects.
4. Notify Architect one week in advance of the dates and times when mockups will be erected.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Specification Sections and as follows:

1. Approximately 2 weeks prior to scheduled commencement of masonry mock-up construction and associated work, conduct conference at Project site with mason, block, sealant, and mortar manufacturer's representatives, wall flashing/insulation installer, Owner, Architect, and engineer testing and inspection agency. Record discussions of conference, decisions and agreements reached, and furnish copy of record to each party attending.
 - a. Testing and inspections required.
 - b. Means and methods that will be employed.
 - c. Cold weather and hot weather procedures, as applicable.
 - d. Items to be addressed prior to and during the work.
 - e. Protection of adjacent surfaces required.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry materials to project in undamaged condition. Protect masonry materials from moisture during delivery.
- B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.
- C. Store cementitious materials off the ground, under cover, and in dry location.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Store masonry accessories including reinforcement, ties, and metal accessories off the ground to prevent accumulation of dirt and oil or permanent distortions.

1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down all sides and hold cover securely in place. When work is resumed, clean top surfaces of loose mortar and other foreign matter.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed. Remove immediately any grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
- C. Cold-Weather Construction: Comply with Section 1.8C of TMS 602 for cold-weather construction and the following:
 - 1. Do not lay masonry units that are saturated, wet, or frozen from rain or snow.
 - 2. Remove masonry damaged by freezing conditions. Remove visible ice and snow from the top surface of existing foundations and masonry to receive new construction. Heat these surfaces above freezing using methods that do not result in damage.
 - 3. No masonry shall be set when air temperatures are below 40 degrees Fahrenheit without a cold-weather construction procedure in accordance with Section 1.8C of TMS 602, approved by the Engineer.
- D. Hot-Weather Construction: Comply with Section 1.8D of TMS 602 for hot- weather construction and the following:
 - 1. Remove masonry where mortar became dry before it cured.
 - 2. No masonry shall be set when air temperatures are greater than 100 degrees Fahrenheit or exceed 90 degrees Fahrenheit with a wind velocity greater than 8 miles per hour without a hot-weather construction procedure in accordance with Section 1.8D of TMS 602, approved by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Comply with TMS 602 and other requirements specified in this Section applicable to each material indicated.

2.2 CONCRETE MASONRY UNITS

- A. General: Comply with requirements indicated below applicable to each form of concrete masonry unit required.
 - 1. Provide special shapes where indicated and as follows:
 - a. Square-edged units for outside corners.
 - 2. Size: Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units.
 - a. Face dimension of 7-5/8 inches or 11 5/8 inches high by 15-5/8 inches long by width required for application.
 - b. Linear Shrinkage: Shall not exceed 0.065%.
 - c. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
 - d. Bond Pattern: Running bond.
- B. Hollow Load-Bearing Concrete Masonry Units: ASTM C90 and as follows:
 - 1. Unit Compressive Strength: Provide units with minimum average net area compressive strengths listed below or as indicated on the drawings, whichever is greater:
 - a. Bearing Walls: Minimum design compressive strength (f_m) of 2,000 psi, and minimum unit net area compressive strength of 2,000 psi.
 - b. Interior Non-Load-Bearing Partition Walls: Minimum design compressive strength (f_m) of 2,000 psi, and minimum unit net area compressive strength of 2,000 psi.
 - 2. Weight Classification: As noted on the drawings.

2.3 MORTAR MATERIALS FOR CONCRETE MASONRY UNIT WALLS

- A. Mortar Mix: ASTM C270, Type S, proportions per the Structural General Notes.
- B. Mortar Cement: Portland cement, ASTM C150, Type I or II.
- C. Mortar Aggregate: Natural color, ASTM C144.
- D. Water: Clean and fresh from public water system.

- E. Hydrated Lime: ASTM C207, Type S.
- F. Do not add admixtures, including coloring pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride in mortar or grout.

2.4 GROUT FOR CONCRETE MASONRY UNIT WALLS

- A. Compressive Strength (fg): ASTM C1019; minimum 28-day compressive strength of grout must equal or exceed f_m , but not be less than 2,000 psi minimum.
- B. Slump: 8 to 11 inches.
- C. Grout Cement: Portland cement, ASTM C150, Type I or II.
- D. Cementitious Replacement: As permitted by ASTM C476, blended hydraulic cements meeting ASTM C595 may be used. Fly ash or pozzolans may be used as cement replacements for 15 to 40 percent of the total weight of cementitious material. Fly ash shall be class F, meeting ASTM C618 requirements. Ground granulated blast furnace slag shall meet ASTM C989 requirements. Grout with cementitious replacements shall provide minimum grout compressive strength specified at 28-day tests.
- E. Grout Aggregate: Coarse grout, ASTM C404, maximum aggregate size 3/8 inch.
- F. Grout Additives: Grout-enhancing shrinkage-compensating additive, Sika Grout Aid or approved equal.
- G. No proportioning or mixing of grout on site.
- H. Do not add admixtures, including coloring pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride in mortar or grout.

2.5 REINFORCING STEEL

- A. General: Provide reinforcing steel complying with requirements of Section 2.4 of TMS 602 and Section 03 20 00, "Concrete Reinforcement."
- B. Steel Reinforcing Bars: Carbon steel complying with ASTM A615, Grade 60.

2.6 JOINT REINFORCEMENT

- A. General: Provide joint reinforcement complying with requirements of Section 2.4C of TMS 602, formed from the following:

1. Galvanized carbon steel wire, coating class as required by referenced unit masonry standard.
- B. Description: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:
 1. Wire Diameter for Side Rods: 9 gage.
 2. Wire Diameter for Cross Rods: 9 gage, minimum.
 3. Ladder design with perpendicular cross rods spaced not more than 16 inches on center with single pair of side rods.

2.7 EMBEDDED MATERIALS

- A. Bent-Bar Anchors: ASTM F1554 Grade 36 galvanized steel with Class 1A threads.
- B. Headed Anchor bolts: ASTM A307, Grade A
- C. Sheet Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7, Section 07 62 00, "Sheet Metal Flashing and Trim."

2.8 MISCELLANEOUS MATERIALS

- A. Masonry Cleaners
 1. Proprietary Acidic Cleaner: Manufacturer's standard-strength general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated below without discoloring or damaging masonry surfaces and without leaving any chloride residue; expressly approved for intended use by manufacturer of masonry units being cleaned:
 - a. For masonry not subject to metallic oxidation stains, use formulation consisting of a manufacturer's standard strength blend of surface-acting acids, chelating, and wetting agents.
 2. Products: Subject to compliance with requirements, a product that may be used to clean unit masonry surfaces includes the following, or as approved by addenda:
 - a. "Sure Klean No. 600 Detergent," ProSoCo, Inc.
 - b. "Sure Klean No. 101 Lime Solvent," ProSoCo, Inc.
 - c. "Sure Klean Vana Trol," ProSoCo, Inc.
- B. Bituminous Coating: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.

- C. Masonry Sealer: See Section 07 19 00, "Water Repellents," for required sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.
1. Verify that foundations are constructed within a level alignment tolerance of +/- 1/2 inch.
 2. Verify that reinforcing dowels are positioned in accordance with the Project Drawings.
 3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.
- B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean reinforcement and shanks of anchor rods by removing mud, oil, or other materials that will adversely affect or reduce bond at the time mortar or grout is placed. Reinforcement with rust, mill scale, or a combination of both are acceptable without cleaning or brushing provided the dimension and weights, including heights of deformations, or a cleaned sample are not less than required by the ASTM specification covering this reinforcement in this Section.
- B. Prior to placing masonry, remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.
- C. Do not wet concrete masonry units before laying. Wet cutting is permitted.
- D. Debris: Construct grout spaces free of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.
- E. Reinforcement: Place reinforcement and ties in grouted spaces prior to grouting.
- F. Cleanouts: Provide cleanouts in the bottom course of masonry for each grout pour when the grout pour height exceeds 5.33 feet.
1. Construct cleanouts so that the space to be grouted can be cleaned and inspected. In solid grouted masonry, space cleanouts horizontally a maximum of 32 inches on center.

2. Construct cleanouts with an opening of sufficient size to permit removal of debris. The minimum opening dimension shall be 3 inches.
3. After cleaning, close cleanouts with closures braced to resist grout pressure.

3.3 INSTALLATION, GENERAL

- A. Comply with Part 3 of TMS 602 and other requirements indicated applicable to each type of installation included in Project.
- B. In the starting course on foundations and other supporting members, construct bed joints with minimum thickness at least 1/4 inch thick but not more than:
 1. 1-1/4 inch thick when masonry is solid grouted and supported by a concrete foundation.
 2. 3/4 inch thick when the masonry is ungrouted or partially grouted.
- C. Thickness: Build multiple wythe walls to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.
- D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.
- E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Use only half-size pieces or larger. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.
- F. Design, provide, and install bracing that will assure stability of masonry during construction. Remove bracing only after permanent wall supports provided.

3.4 CONSTRUCTION TOLERANCES

- A. Erect masonry within the following tolerances from the specified dimensions:
 1. Dimension of elements:
 - a. In cross section of elevation: - 1/4 inch, + 1/2 inch.
 - b. Mortar joint thickness:
 - 1) Bed: +/- 1/8 inch.
 - 2) Head: - 1/4 inch, + 3/8 inch.
 - 3) Collar: - 1/4 inch, + 3/8 inch.

- c. Grout space or cavity width, except for masonry walls passing framed construction: - 1/4 inch, + 3/8 inch.
- 2. Elements:
 - a. Variation from level:
 - 1) Bed joints: +/- 1/4 inch in 10 feet, +/- 1/2 inch maximum.
 - 2) Top surface of bearing walls: +/- 1/4 inch in 10 feet, +/- 1/2 inch maximum.
 - b. Variation from plumb: +/- 1/4 inch in 10 feet, +/- 3/8 inch in 20 feet, +/- 1/2 inch maximum.
 - c. True to a line: +/- 1/4 inch in 10 feet, +/- 3/8 inch in 20 feet, +/- 1/2 inch maximum.
 - d. Alignment of columns and walls (bottom versus top):
 - 1) Bearing walls and columns: +/- 1/2 inch.
 - 2) Nonbearing walls: +/- 3/4 inch.
- 3. Location of elements:
 - a. Indicated in plan: +/- 1/2 inch in 20 feet, +/- 3/4 inch maximum.
 - b. Indicated in elevation: +/- 1/4 inch per story, +/- 3/4 inch maximum.
- 4. Reinforcement placement:
 - a. Walls and flexural elements: +/- 1/2 inch where distance from centerline of reinforcing bar to opposite face of masonry, d , is less than or equal to 8 inches, +/- 1 inch for d less than 24 inches but greater than 8 inches, and +/- 1 inch for d greater than 24 inches.
 - b. Vertical bars along the length of the wall: +/- 2 inches for wall segments greater than 24 inch in length, and +/- 1 inch for wall segments less than or equal to 24 inch in length.
 - c. Foundation dowels that interfere with unit webs are permitted to be bent to a maximum of 1 inch horizontally for every 6 inches of vertical height.
- 5. If the above conditions cannot be met due to previous construction, notify the Architect/Engineer.

3.5 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-

than-half-size units at corners, jambs, and where possible at other locations.

- B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.
- C. Bond Pattern: Lay masonry in running bond pattern as shown on drawings, except where otherwise indicated.
- D. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond or 1/3-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.
- E. Remove masonry units disturbed after laying. Clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.
- F. Built-In Work: As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
 - 1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 - 2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
 - 3. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.6 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 - 1. With full mortar coverage on horizontal and vertical face shells.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
- B. Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.
- C. Mortar Joints: Make all joints of uniform thickness, approximately 3/8 inch. Take care to see that all holes, depressions, cracks, and other defects are completely filled. Work mortar with tool to smooth and uniformly profiled shape. Upon completion of the work, reinspect all joints; fill all cracks and holes; remove any loose mortar by cutting out; fill and tool to match other joints.

- D. Head Joints: Provide mortar buttering on all four edges which ensures full head joints.

3.7 HORIZONTAL JOINT REINFORCEMENT

- A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere.
- B. Provide minimum 6-inch lap splices for joint reinforcement.
- C. Cut or interrupt joint reinforcement at control and expansion joints.
- D. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 MOVEMENT (CONTROL AND EXPANSION) JOINTS

- A. General: Install control and expansion joints in unit masonry where indicated in the contract documents. Build in related items as the masonry progresses. Reinforcement shall not cross movement joints except at floor and roof levels where shown on the drawings. Finishes shall not cross movement joints.
- B. Form control joints in concrete masonry as follows:
 - 1. Install special shapes designed for control joints. Install bond breaker strips at joint. Keep head joints free and clear of mortar or rake joint.
- C. Build in horizontal pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting nonmetallic 50 percent compressible joint filler of width required to permit installation of sealant and backer rod specified in Division 7, Section 07 92 00, "Joint Sealants."

3.9 INSTALLATION OF REINFORCED UNIT MASONRY

- A. General: Install reinforced unit masonry to comply with requirements of Part 3 of TMS 602.
- B. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
 - 1. Place grout within 1-1/2 hour from introducing water in the mixture and prior to initial set.
 - 2. Grout pour height shall not exceed the maximum grout pour height listed in Table 6 of TMS 602.
 - 3. Grout lift height shall not exceed 12.67 feet.

- a. Grout lift height shall not exceed 5.33 feet except where a high-lift grouting procedure in accordance with the requirements of TMS 602 Section 3.5D has been approved by the Architect and Engineer.
- C. Consolidate grout at the time of placement in accordance with the requirements of TMS 602 3.5E.
- D. Form grout keys between grout pours when the first lift is permitted to set prior to the placement of the subsequent lift.
 - 1. Form a grout key by terminating the grout a minimum of 1 1/2 inch below a mortar joint.
 - 2. Do not form grout keys within beams.
 - 3. At beams or lintels laid with closed bottom units, terminate the grout pour at the bottom of the beam or lintel without forming a grout key.
- E. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

3.10 BRACING OF MASONRY

- A. Temporary Formwork: Construct formwork and shores to support reinforced masonry elements during construction.
 - 1. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
- B. Design, provide, and install bracing that will assure stability of masonry during construction.

3.11 FIELD QUALITY CONTROL

- A. General: The Owner will employ a testing laboratory to perform tests and inspections or will perform inspections themselves or a combination of both.
 - 1. Testing and inspection or quality control as required by Section 01 45 00, "Structural Testing, Inspection, and Quality Assurance".
- B. Inform Architect two weeks prior to installation of backer rod and sealant at expansion joints. Provide equipment, such as scaffolding with interior stairway, which will safely allow Architect and Owner's inspector to examine all vertical and horizontal expansion joints prior to sealing.

3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
 - 4. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 5. Clean concrete masonry by means of cleaning method indicated in NCMA TEK 45 applicable to type of stain present on exposed surfaces.
 - 6. Do not use pressure-washing equipment to apply water sealant coatings or to clean the masonry.
- D. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 051200 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Features:

- 1. Structural steel fabrication and erection required for completion of the work.
 - 2. Delegated design of structural steel connections.

- B. Related Sections:

- 1. 013300 – Submittal Procedures
 - 2. 014500 – Structural Testing, Inspection, and Quality Assurance
 - 3. 017100 – Construction Tolerance
 - 4. 052100 - Steel Joist Framing
 - 5. 053100 – Steel Decking
 - 6. 078100 – Applied Fireproofing
 - 7. 099600 – High Performance Coatings

1.3 REFERENCE STANDARDS

- A. General: Comply with the provisions of the latest versions of the publications listed below except as otherwise shown or specified.

- B. American Institute of Steel Construction (AISC):

- 1. AISC Steel Construction Manual
 - 2. AISC 303 Code of Standard Practice for Steel Buildings and Bridges, as modified herein
 - 3. AISC 341 Seismic Provisions for Structural Steel Buildings.
 - 4. AISC 360 Specifications for Structural Steel Buildings

- C. American Society for Testing and Materials (ASTM):

- 1. ASTM A6 Standard Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars
 - 2. ASTM A36 Standard Specification for Carbon Structural Steel
 - 3. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

4. ASTM A123 Zinc (Hot-Dip Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip
5. ASTM A307 Carbon Steel Externally and Internally Threaded Standard Fasteners
6. ASTM A435 Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
7. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
8. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
9. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
10. ASTM A588 High-Strength Low-Alloy Structural Steel with 50,000 PSI Minimum Yield Point to 4-Inch Thickness
11. ASTM A706 Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
12. ASTM A898 Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes
13. ASTM A913 High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by the Quenching and Self-Tempering Process (QST)
14. ASTM A992 Standard Specifications for Steel for Structural Shapes for Use in Building Framing
15. ASTM F959 Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
16. ASTM F3125 Standard Specifications for High-Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

D. American Welding Society (AWS):

1. AWS A2.4 Welding Symbols
2. AWS A3.0 Terms and Definitions
3. AWS A5.1 Specifications for Carbon Steel Electrodes for Shielded Metal Arc Welding
4. AWS A5.5 Specification for Low-Alloy Electrodes for Shielded Metal Arc Welding
5. AWS A5.17 Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
6. AWS A5.20 Specification for Carbon Steel Electrodes for Flux Cored Arc Welding
7. AWS A5.23 Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
8. AWS A5.29 Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding
9. AWS D1.1 Structural Welding Code - Steel
10. AWS D1.4 Reinforcing Steel Welding Code, including Metal

Inserts and Connections in Reinforced Concrete

11. AWS D1.8 Structural Welding Code - Seismic Supplement

E. Research Council on Structural Connections (RCSC):

1. RCSC Specification for Structural Joints Using High-Strength Bolts

1.4 DEFINITIONS

- A. Fabricator's Engineer – The engineer licensed to perform the work in the jurisdiction where the work is performed and retained by the steel fabricator who is responsible for the delegated connection design.
- B. Delegated Connection Design – Detailed design of steel connections performed by the Fabricator's Engineer in accordance with the connection design criteria specified in the Structural Drawings

1.5 STRUCTURAL DRAWINGS

- A. The Contract Documents are complementary. The Structural Drawings shall not be considered a stand-alone document. The Contractor shall use the Structural Drawings in conjunction with all of the Contract Documents, including but not limited to the Architectural, Civil, Mechanical, and Electrical Drawings. Locations of steel members not provided in the Structural Drawings shall be determined from these other Drawings.
- B. Delete Sections 2.1 and 2.2 from AISC 303 and replace with the following:
- 2.1 Definition of Structural Steel
Structural Steel shall consist of the elements of the structural frame that are shown and sized in the structural Design Drawings.
- 2.2 Other Steel, Iron, or Metal Items
Structural Steel shall not include other steel, iron, or metal items that are not shown and sized in the structural Design Drawings.
- C. Section 3.1 and 3.2 from AISC 303 pertaining to the accurate dimensioning of structural steel shall be subject to the following additional requirements:
1. Dimensions and locations of steel framing shall be determined from the Structural Drawings as well as all other construction documents, including but not limited to the Architectural and MEP Drawings. It shall be the Contractor's responsibility to coordinate the dimensions of the structural steel between all of the construction documents.
- D. Section 4.4 from AISC 303 pertaining to Approval shall be subject to the following additional requirements:

1. The review of submitted shop erection drawings will be in accordance with Division 1.
2. Submitted shop and erection drawings may not necessarily be individually annotated as approved or subject to corrections.
The submittal as a whole will be noted by the Structural Engineer as “No Exceptions Taken,” “Make Corrections Noted,” “Revise and Resubmit,” or “Not Reviewed.”
Correction notations specific to each piece will be noted.
3. The Fabricator’s Engineer shall be responsible for the detailed design of the connections between members. The project structural engineer shall review the submitted connection design information to confirm that the Delegated Connection Design conforms to the specified design criteria and that the proposed methods of connection do not substantively impact the anticipated performance of the primary structure.

1.6 DELEGATED CONNECTION DESIGN STRUCTURAL PERFORMANCE REQUIREMENTS

A. Connections: General

1. Connection designs shall be provided for all connections not completely detailed on the drawings. Connections shall be designed per AISC 360 and shall develop the ultimate loads shown on the drawings.
2. Where shown on the drawings, indicative details may not fully represent the complexity of the connection as required by the final connection design for the forces they must resist.
3. Where shown on the drawings, indicative details may provide additional requirements beyond what is required by the final connection design for the forces they must resist.
4. Design and provide all additional connection elements not specifically shown in the indicative details as required by the final connection design such as stiffener plates, doubler plates, supplemental/reinforcing plates, shims, fillers, or any other connection material.

B. Shear Connections: Provide flexible connections capable of accommodating end rotations of the unrestrained beams and girders unless noted otherwise on the drawings.

C. Axial Connections: Provide connection capable of transferring the forces indicated on the drawings, including any strengthening of the net section and supporting section. Where forces are not indicated, design for the full capacity of the section.

D. Moment Connections: Moment connections shall be designed by the fabricator to resist the full plastic moment capacity of the connection beam unless the required ultimate moment is indicated on the drawings.

1. Design and provide all additional reinforcement in moment connected joints to resist the specified design forces unless otherwise specifically detailed on the drawings. Column sections

shall be investigated for flange bending, web yielding, web crippling, web buckling, and web panel zone shear.

E. Truss Connections:

1. Chord and web lines shown on truss elevations represent the centroid of the truss member unless otherwise shown on the drawings.
2. Provide connections capable of transferring the forces indicated on the drawings, including any strengthening of the net section and supporting section. Where forces are not indicated, design for the full capacity of the section.
3. Where only a compression force is indicated, the connection shall also be designed to resist a tension force not less than 50 percent of the indicated compression force.

F. Braced Frame Connections:

1. Work lines shown on the frame elevations represent the centroid of the bracing, beams, and columns unless otherwise shown on the drawings.
2. Bracing connections shall be designed for the forces indicated on the drawings. Where only a compression force is indicated, the connection shall also be designed to resist a tension force not less than 50 percent of the indicated compression force.
3. Design and provide steel plates welded to the member cross section as required where material has been removed for bolts or weld access holes such that the member does not fail by fracture of the net section.

1.7 QUALITY CONTROL

A. Fabricator/Erector:

1. Must have plant, facilities, and personnel sufficient to fabricate and/or erect structural steel indicated on the drawings. Must have minimum of 5 years' experience with a record of successful in-service performance and be able, upon request, to show framing of size, materials, and scope similar to work of this contract. Must demonstrate sufficient production capacity to provide structural steel indicated on the drawings.
2. Must have a Quality Control Plan established in accordance with AISC 360 Chapter N; quality control procedures shall be established and maintained in accordance with these requirements.

B. Material: Provide only structural steel certified as conforming with specified requirements and fabricate specifically to the requirements of this contract. Material that does not conform to the requirements of this contract may be rejected at any time.

C. Charpy V-Notch Testing: Testing shall be in accordance with ASTM A6, Supplement S5 or S30, where this testing is specifically required.

- D. Allowable Tolerances: Unless otherwise specified or noted on drawings or in Section 01 71 00, "Construction Tolerance," provide structural steel work in accordance with the following minimum tolerances:
1. Fabrication Tolerances: In accordance with requirements of AISC specification unless noted otherwise and as required to maintain the erection tolerances specified herein.
 2. Erection Tolerances: In accordance with requirements of AISC. The Contractor alone shall be responsible for the correct fitting of all structural members and for the elevation and alignment of the finished structure. Any adjustment necessary in the steel frame because of discrepancies in elevations and alignment shall be the responsibility of the Contractor.
- E. Connection Identification: Each person installing connections shall be assigned an identifying symbol or mark, and all shop and field connections shall be so identified so that the Owner's Testing Agency can refer to the person making the connection.
- F. Testing and Inspections: Work is subject to special testing and inspection in accordance with the Building Code, AISC 360 Chapter N. Refer to Section 01 45 00, "Structural Testing, Inspection, and Quality Assurance." The Fabricator/Erector shall provide the Owner's Testing Agency and the Architect/Engineer access to places where material is being fabricated/erected. Notice shall be given for joints requiring inspection for proper end preparation, root opening, etc., prior to welding.
- G. Delegated Connection Design Engineering: The Fabricator's engineer shall be a professional engineer licensed to perform the work in the jurisdiction where the project is located, who is experienced and qualified to provide engineering services of the kind indicated.
- H. Welder Qualifications: Each welder performing work on this project shall be qualified before commencement of welding on this project in accordance with the American Welding Society, AWS D1.1. Copies of each welder's qualification records shall be made available to the Architect and Owner's Testing Agency for review.
- I. Inspections: A qualified inspector under the requirements of the building code shall continuously inspect field welds.
- J. Bolting Quality Assurance: The bolt supplier shall visit the project site or fabrication plant if bolt installation is to be performed during the bolting start-up to demonstrate proper installation procedures and verify inspection procedure with the Contractor, Erector, and the Owner's Testing Agency. The Contractor shall distribute written verification of the visit to the attending parties, Owner, Architect, and Owner's Structural Engineer.
- K. Shop Testing by Contractor: The Contractor shall perform ultrasonic testing and visual inspection for discontinuities of all plate material

and rolled sections greater than 1-1/2 inches in thickness and located at welded connections where the base metal is subjected to through- thickness weld shrinkage strains prior to fabrication. The test area is defined as a zone up to 6 inches away from the weld in the connection. These tests shall be in addition to the ultrasonic testing of all complete joint penetration welds and base metal that will be performed by the Owner's Testing Agency after joint completion. The Contractor's testing shall be submitted to the Architect/Engineer and Owner's Testing Agency. All costs associated with this testing shall be borne by the Contractor.

1. Ultrasonic Testing of Plate Material: Conduct in accordance with ASTM A435 and the following modifications and supplementary requirements:
 - a. Supplementary Requirements S1, requiring 100% scanning of the test area, are to be included.
 - b. Section 5.2, Acceptance Standards, is supplemented with the following provision: "The fabricator, insofar as practical, may reposition a rejected plate so that rejectable defects are not located in a test area."
2. Ultrasonic Testing of Wide Flange Material: Conduct in accordance with ASTM A898, Level I acceptance standard.

- L. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- M. Pre-Construction Conference: Schedule a job conference to review the Structural Documents prior to development of shop drawings. The conference shall be attended by all pertinent parties, which is, at a minimum, to include the Fabricator, Erector, Contractor, Owner's Testing Agency, and Structural Engineer.

1.8 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00, "Submittal Procedures."
- B. Shop Drawings: Submit shop drawings for review prior to commencing any fabrication of structural steel.
 1. Show framing layout, dimensions, connections with adjoining materials and construction, finishes, welds, bolts and fasteners, anchoring, and all fabrication or erection accessories required.
 2. Specify field welds, cuts, holes, and fasteners.
 3. Verify all dimensions and correlate with adjoining construction and materials.
 4. Indicate size, type, and grade of all members.

5. Include with each detail shown on the shop drawings a reference to the Architect's and Engineer's drawings and details, where applicable.
6. Prior to shop drawing submittal, the Contractor and Fabricator shall review the drawings for obvious drafting and detailing errors.
7. The Fabricator shall either employ or retain a Fabricator's Engineer. The Fabricator's Engineer shall review and approve the delegated connection information in the structural steel shop drawings prior to submittal to the Architect.
8. The Fabricator's Engineer shall seal, date, and submit a letter simultaneously with the first submittal of structural steel shop drawings stating the following: "The Delegated Connection Design and delegated connection design information in the structural steel shop drawings prepared for this project have been or will be reviewed and approved under my direct supervision."
9. Structural steel shop drawings will not be reviewed by the Architect until the letter from the Fabricator's Engineer is received.

C. Connection Calculations

1. Submit calculations for connections not completely detailed on the drawings. Calculations shall be sealed by the Fabricator's Engineer.
2. Calculations shall be submitted with the first shop drawing submittal and shall be cross-referenced with all shop drawing submittals.
3. Shop drawings will not be reviewed without the submittal of coordinated connection calculations.

D. One month prior to commencing fabrication, submit Fabricator's quality control procedures to the Architect, Engineer, Owner, and Owner's Testing Agency.

E. Indicate welded connections on shop drawings using standard AWS welding symbols. Show all welded connections with details showing size, length, location, and type of welds.

F. Mill Reports: Submit three copies of certified mill reports indicating heat and melt numbers of steel. Mill reports are to be submitted for record only and will not be reviewed:

1. If test reports are not submitted or test reports cannot be identified with material proposed for use in the work, then secure and perform structural tests on 5% of all such unidentified steel.
2. Contractor shall furnish all such material for testing and pay for all such tests.
3. Furnish Owner, Architect, and Structural Engineer certified copies and Fabricator one certified copy of all test reports.

- G. Inspection Test Reports: Upon request, submit to Architect copies of Contractor's ultrasonic testing reports.
- H. Placement Plans: Submit placement plans and details as required for the satisfactory placing, connection, and anchorage of all structural members.
- I. Survey Reports: Promptly submit an accurate survey of actual elevations and locations of base plates and anchor rods, and alignments as well as elevations of all steel as noted on the drawings. The report shall specify that the location of the structural steel is acceptable for plumbness, level, and alignment within the specified tolerances.
- J. Certification: Submit manufacturer's certified test reports on compressible washer-type direct tension indicators and/or tension control bolts on at least three samples from each heat supplied to conform to tolerance range.
- K. Welding Procedures: For welded joints prequalified and non- prequalified by AWS D1.1 and D1.8, submit a Welding Procedure Specification a minimum of one month prior to use. Furnish joint welding procedure qualification tests as required by AWS D1.1 and D1.8 for non-prequalified welded joints. Welding procedures shall be reviewed by the Owner's Testing Agency, and an approved copy shall be forwarded to the Structural Engineer.
- L. Manufacturer's Certification is required as follows:
 - 1. Bolts, Nuts and Washers: Furnish complete manufacturer's mill test reports conforming to ASTM F3125 Grade A325, F1852, A490, or F2280. Markings and chemistry must also comply with the specification. Certification numbers must appear on product containers and correspond to certification numbers on mill test report to be accepted. Mill test report must be supplied to both purchaser and Owner's Testing Agency.
 - 2. Filler material for welding.
- M. Product Data: For shop primers, include manufacturer's technical information including basic materials analysis and application instructions.
- N. Structural Calculations: Submit structural calculations for connections that are designed by the Contractor as required in the construction documents. These calculations shall be prepared by an engineer licensed to perform the work in the jurisdiction where the project is located.
- O. Environmental Product Declarations (EPDs): For structural steel types, submit product-specific Type III EPDs conforming to ISO 14025 and ISO 21930 including Life Cycle Assessment Modules A1-A3 which at a minimum

must include Global Warming Potential (GWP). Submit EPDs for a minimum of 90 percent by weight of all steel used in the project.

- P. Recycled Content: For LEED v4 documentation and points, submit documentation of the materials' percent recycled content compared to totals, measured by weight or volume.
- Q. Bill of Materials: Submit steel weight per steel element type and grade as outlined in table below prior to start of construction and at completion of construction based on material delivered to project site.

ELEMENT	SPEC, GRADE (KSI)	WEIGHT (US ton or metric tonne)	GWP (kg CO ₂ eq / metric tonne)
W-SHAPE BEAMS	ASTM A992, Fy=50		
W-SHAPE COLUMNS	ASTM A913, Fy = 65		
HSS BEAMS	ASTM A500, GR B Fy = 46		
HSS COLUMNS	ASTM A500, GR B Fy = 46		
OTHER ELEMENTS			

NOTES:

- SUPPLIER TO SUBMIT TABLE USING PROJECT-SPECIFIC INFORMATION.
- SUPPLIER TO REPORT ANY ASSUMPTIONS AND ALLOWANCES INCLUDED IN AMOUNTS.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the general conditions and of ASTM A6, including the following.
- B. Store materials in a manner to permit easy access for inspection and identification.
- Keep steel members off the ground, using pallets, platforms, or other supports.
 - Protect steel members and packaged materials from corrosion and deterioration.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replace damaged materials or structures at no additional cost to the Owner.
- D. Columns, beams, girders, and other members that are to receive sprayed-on fireproofing shall be free of loose rust, heavy mill scale, oil, dirt, or other foreign substances prior to application of fireproofing materials.
- E. All fasteners shall be stored and protected in accordance with the current requirements of the "Specification for Structural Joints Using High-Strength Bolts."

1.10 JOB CONDITIONS

- A. Temporary Bracing: Temporary bracing and guylines shall be provided to adequately protect all persons and property and to ensure proper alignment.
- B. Temporary Floors: All temporary flooring, planking, and scaffolding necessary in connection with the erection of the structural steel or support of erection machinery shall be provided. The temporary floors or use of steel decking shall be as required by law and governing safety regulations. The reduced load capacity of members and assembly, especially the floor and roof beams and girders due to their unbraced condition prior to welding of steel deck and completion of concrete slabs, is hereby noted and shall be considered.
- C. Holding and Protection: In assembling and during welding, the component parts shall be held with sufficient clamps or other adequate means to keep parts straight and in close contact. In welding, precautions shall be taken to minimize "lock-up" stress and distortion due to heat. In windy conditions, welding shall be done only after adequate wind protection is furnished and set up and as specified in the AWS.

1.11 CONDITION OF STEEL

- A. Pre-Fireproofing Inspection: The Contractor, structural steel erector, sprayed-on fireproofing applicator, and the Owner's Testing Agency shall conduct a visual inspection of all structural steel prior to receiving fireproofing. The purpose of this inspection is to check for foreign substances on the surfaces, which could impair adhesion. Any cleaning that may be necessary as a result of this inspection shall be done at no additional cost to the Owner.
- B. Application of the sprayed-on fireproofing will not commence until all steel surfaces have been accepted by the sprayed-on fireproofing subcontractor and material manufacturer. No additional compensation shall be granted to the Contractor, structural steel erector, or fireproofing applicator should it be determined at a later date that foreign substances, which were allowed to remain on the steel surfaces, will have a detrimental effect in obtaining total adhesion in accordance with specification Section 07 81 00, "Applied Fireproofing."

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

- A. Carbon Steel and High-Strength Low-Alloy Steel: Provide steel shapes, plates, and bars of structural quality, sizes, and standards noted on drawings for use in welded and bolted construction. Steel manufactured by the acid bessemer process shall not be used for structural purposes. Steel that, in the opinion of the Owner's Testing Agency, is badly

corroded or physically damaged shall not be incorporated in the work until the Owner's representatives, Contractor, Erector, and Fabricator have agreed to allow the installation.

- B. Primer: Fabricators standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer.
 - 1. Weldable primers shall not be used.
 - 2. Where other coatings (intumescent paint, architectural paint, etc.) are to be applied, use the appropriate primer as required per the architectural coatings specifications and as required to be compatible with these other coatings.
- C. Standard Fasteners: Low-carbon steel externally and internally threaded fasteners conforming to requirements of ASTM A307, Grade A. Provide hexagonal heads and nuts for all connections. Include lock washers under nuts or self-locking nuts.
- D. High-Strength Fasteners: Quenched and tempered steel bolts and nuts conforming to requirements of ASTM F3125.
 - 1. Washers other than compressible washer type direct tension indicators shall be hardened steel.
 - 2. Compressible washer type direct tension indicators, where used, shall conform to ASTM F959.
 - 3. Any proposed substitutions must have documentation submitted for review and approval of the Structural Engineer one month prior to construction.
- E. Weld Electrodes: See AWS D1.1 and AWS D1.8 for requirements.
- F. Headed Shear Connector Studs, Deformed Bar Anchors: Refer to Section 05 31 00, "Steel Decking," for specific requirements at composite floor deck.
 - 1. Headed Shear Connector Studs: Shall be Type B in accordance with AWS D1.1 and comply with ASTM A29, Grade 1010 or 1020; of dimensions complying with AISC specifications and the contract drawings; through deck stud welded shear connectors. Install in such a manner as to provide complete fusion between the end of the stud and structural steel base material.
 - 2. Deformed Bar Anchors: ASTM A706, Grade 60, of dimensions per plan. Install in such a manner as to provide complete fusion between anchor and base material. Nelson D6L A706 Weld Studs, Tru-Weld A706 Stud Weldable Rebar, or approved equal.
 - 3. All steel stud/anchors welded to steel beams or plates shall be "Tru-weld studs," Division of Tru-Fit Screw Products Corporation, Cleveland, Ohio; "Nelson Stud," Division of Gregory Industries, Inc., Lorain, Ohio; or approved equal. All stud anchors shall be automatically end-welded in shop or field with equipment recommended by manufacturer of studs and anchors.

4. All welded connectors are to be end welded in accordance with AWS D1.1 Clause 7. Base metal is to be clean, dry, and free of paint, rust, oil, scale, or other contaminants. Welding should not be done when the base metal temperature is below 0°F or when the surface is wet or exposed to falling rain or snow.
5. Where threaded studs are specified, the stud shall utilize a reduced weld base so that the weld flash will match the diameter of the fastener.

G. Drilled-in-Concrete Anchors: Refer to structural drawings.

H. Slab Edge/Deck Supports: Refer to Section 05 31 00, "Steel Decking," for specific requirements at composite floor deck.

1. Provide additional structural steel support framing for steel deck where normal deck bearing is precluded by column flange plates or other framing members.
2. The Contractor shall make specific provisions to provide the necessary framing materials at slab and roof edge conditions. The Contractor shall provide and install all gage metal edge closures where required by the plans and specification and shall coordinate shoring requirements at composite slab edges. The Contractor shall provide and install all structural steel bent plate edge closures or structural steel edge materials and any corresponding bracing or shoring where required by the plans and specifications.

I. Grout: Refer to Structural General Notes.

J. Other Materials: Provide all incidental and accessory materials, tools, methods, and equipment required for fabrication and erection of structural steel framing as indicated on drawings. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

K. General: Miscellaneous materials or accessories not listed above shall be provided as specified herein under the various items of work and as indicated on the drawings or required for good construction practice.

2.2 FABRICATION

A. Fabricate all steel in accordance with requirements of AISC specifications and in accordance with details indicated on the drawings or as approved on shop drawings.

1. Identify all steel at mill showing ASTM standard grade.
2. Identify each piece with an erection mark corresponding to identifications noted on erection drawings.

B. Materials shall be properly identified with an erection mark corresponding to identifications noted on erection drawings and match-

marked where field assembly requires. The sequence of shipments shall be such as to expedite erection and minimize the field handling of material.

- C. Cutting: All holes and openings must be approved by the Owner's Structural Engineer.
 - 1. Do no flame cutting by hand of openings greater than 1/2 the depth of the member, unless approved by the Engineer.
 - 2. All flame-cut holes shall be smoothed by chipping, planing, or grinding members to required AISC tolerances.
 - 3. Sharp bends or kinks will not be allowed.
 - 4. Flame cutting by hand will not be allowed for holes at connections.
- D. Milled Surfaces: All milled surfaces shall be completely assembled or welded before milling. Milled surfaces are to provide full contact bearing for the entire cross section.
- E. Beams, girders, and trusses shall be upward cambered where indicated on the drawings. For beams, girders, and trusses without specified cambers, fabricate members so that after erection, any minor camber due to rolling or fabrication is upward.
- F. Connections Designed on the Structural Drawings:
 - 1. The Contractor shall not deviate from these designs unless approved by the Architect and Engineer.
 - 2. Connections shown on the drawings may eliminate certain methods of erection.
 - 3. If the Contractor elects a method of erection that requires a change of some of the connections, it must be approved by the Architect and Engineer.
- G. Combination of bolts and welds shall not be used for stress transmission in the same faying face of any connection without prior approval by the Structural Engineer.
- H. For stud anchor and deformed bar anchor welding, the area where the anchor is to be attached shall be made free of all foreign material such as rust, oil, grease, paint, galvanizing, etc.
 - 1. When the mill scale is sufficiently thick to cause difficulty in obtaining proper welds, it shall be removed by grinding or sandblasting.
 - 2. Use automatic end welding of headed stud shear connectors and deformed bar anchors in accordance with manufacturer's printed instructions.
- I. Welding processes other than shielded metal arc, flux core arc, and submerged arc may be used, provided procedure qualification tests in

accordance with the American Welding Society are made for the intended application of all such processes.

- J. Built-up sections assembled by welding shall be free of warpage, and all faces shall have true alignment.
- K. Types of Welds: Required weld types are indicated by symbols on drawings; characteristics of welds shall be in accordance with standard specifications or codes as applicable; each welder shall mark his identification symbol on his work.
- L. Preparation of Steel Surfaces to be Welded: Prepare edges to be joined by welding as indicated on drawings and in accordance with AWS D1.1. All welds are to be made to sufficiently clean steel. Remove all coatings, galvanizing, grease, scale, rust, and other foreign matter at locations that are to be welded in accordance with AWS D1.1.
- M. Welding Environment: Welding shall not be done when the ambient temperature is lower than 0°F; when surfaces are wet or exposed to rain or snow; when exposed to high wind velocities; or when welding personnel are exposed to inclement weather.
- N. Reinforcing Steel: Welding or tack welding of reinforcing bars to other bars or plates, angles, and similar shapes is prohibited, except where specifically shown on plans or approved by the Structural Engineer; where required, use electrodes in accordance with requirements of AWS D1.4 Clause 7.1 and the Structural General Notes. Welding of reinforcing bars shall only occur at bars conforming to ASTM A706, except where specifically approved by the Structural Engineer.
- O. The toughness and notch sensitivity of the steel shall be considered in the formation of all welding procedures to prevent brittle and premature fracture during fabrication and erection.
- P. Detailing of connections, welding sequences, and preheat methods shall be such as to minimize restraint and the accumulation and concentration of through thickness strains due to weld shrinkage.
- Q. At welded joints that are not hidden by architectural finish materials, remove projecting ends of runoff tabs, backer bars, and any other erection aids, and grind flush with edges of plates.
- R. Cleaning of Steel Surfaces: Clean all surfaces of oil, grease, loose rust, loose mill scale, and other foreign matter present in sufficient quantities to impair bond of spray fireproofing or other specified coatings.
- S. Bolted Faying Surfaces at Slip Critical Connections: Surfaces are to be prepared such that faying surfaces satisfy the requirements for a Class A surface unless noted otherwise.

T. Steel Stud and Deformed Bar Anchors:

1. All anchors shall be automatically end-welded in the shop or field with equipment recommended by the manufacturer of the studs and by qualified welders. Steel stud material, welding, and inspection shall be in accordance with AWS D1.1 Clause 7. End-weld in such a manner as to provide complete fusion between the end of the stud and the plate. There shall be no porosity or evidence of lack of fusion between the welded end of the stud and the plate.
2. Tests and Inspections by the Contractor: Provide testing of deformed bar anchors and studs in accordance with AWS D1.1 Clause 7.
3. Refer to Section 05 31 00, "Steel Decking," for specific requirements at composite floor deck.

U. Shop Priming: Prime steel as follows:

1. Shop prime steel surfaces except the following:
 - a. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - b. Within 2 inches of surfaces to be welded.
 - c. Surfaces to receive sprayed-on fireproofing, unless surfaces will be exposed to moisture.
2. Surface Preparation: Clean surfaces to be primed. Remove loose rust, loose mill scale, and splatter, slag, or flux deposits. Prepare surfaces to SSPC specification as follows:
 - a. SSPC SP3 "Power Tool Cleaning" to a minimum blast profile of 1.5 mils.
3. Priming: Immediately after surface preparation, apply primer according to the manufacturer's instruction and at the rate recommended by SSPC to provide a dry film thickness of not less than 3.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - a. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - b. Apply two coats of primer paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

V. Temperature Effects: Fabrication shall take into consideration all temperature effects relevant to the fabrication, erection, and final condition of the structural frame. Fabrication shall consider that the temperatures which the frame members are subjected to during fabrication, erection, and in their final condition may be significantly different and shall make any adjustments necessary to facilitate proper erection of the frame.

- W. If the Contractor elects a method of erection that requires a change of some of the connections, or otherwise wishes to use alternate connections, the alternate connections must be reviewed and approved by the Architect. The design of all alternate connections is the responsibility of the Contractor. The Contractor shall retain an engineer licensed to perform the work in the jurisdiction where the project is located to prepare details and calculations, which shall be submitted for review and approval by the Architect.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 ERECTION

- A. General: Erect structural steel framing in accordance with governing codes and specifications. Conform to configurations and connections as shown in the documents.
- B. Shoring and Bracing: Provide temporary shoring and bracing members as required and according to the AISC Code of Standard Practice as well as any applicable Local, State, or Federal requirements. The design of the shoring and bracing is the responsibility of the Contractor. The determination of the timing of the installation and removal of the shoring and bracing elements is strictly the responsibility of the Contractor.
- C. Column Base and Bearing Plates: Align attached column bases and bearing plates for beams and similar structural members. Set loose column bases and bearing plates. Grout solid with non-shrink grout as specified.
- D. Field Assembly: Accurately assemble structural framing to lines and elevations indicated within specified or noted tolerances.
 - 1. Align and adjust various members of framing system prior to fastening.
 - 2. Prior to assembly, clean bearing surfaces and surfaces that will be in permanent contact.
 - 3. Splice structural members only where indicated or where approved.
 - 4. Cut holes by drilling only.
 - 5. Fasten splices of compression members after bringing abutting surfaces completely into contact.
 - 6. Make all field connections by high-strength bolting or welding, unless otherwise noted.

7. Unless noted otherwise, tighten and leave erection bolts in place after welding. Where high-strength bolts are required, provide identified and marked bolts.
 8. Do not field cut or alter structural members without the written approval of the Structural Engineer.
 9. Do not use gas-cutting torches for correcting fabrication errors in structural framing.
 10. Finish gas-cut sections equal to a sheared appearance.
- E. Furnish shim plates or develop fills where required to obtain proper fit and alignment.
- F. Non-Fusible Backing Materials: The use of non-fusible backing materials, including ceramic and copper, in accordance with the structural notes, is permitted only with satisfactory welder qualification testing performed using the type of backing proposed for use, using the test plate shown in AWS D1.1, Figure 4.21, except that groove dimensions shall be as provided in the weld procedure specification. Welders using these backings shall be prequalified per AWS.
- G. Composite Construction: This building utilizes composite (concrete and structural steel) construction for various beams and columns. Careful sequencing of steel erection and concrete placement is recommended.
- H. Connections: No welding or bolting shall be done until as much of the structure as will be stiffened by the welding or bolting has been properly aligned.
- I. Drift pins shall not be used to enlarge unfair holes in main material. Holes that must be enlarged shall be reamed up to a maximum of 1/16 inch larger to admit bolts. Burning, drifting, and reaming may be used to align unfair holes in members only after approval by the Owner's Structural Engineer.
- J. Mutilate threads or use lock nuts for unfinished bolts to prevent nuts from backing off. Draw unfinished bolt heads and nuts tight against the work.
- K. Establish required leveling and plumbing measurements on the mean operating temperature of the structure of 65°F unless noted otherwise. Make allowances for differences between temperature at time of erection and mean temperature at which the structure will be maintained when completed and in service.
- L. The steel erector shall leave the steel clean of oil or other contaminants as outlined under Part 2 of this Specification.
- M. Touch-up Priming: Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop primer. Apply primer to exposed area with the same material as used for shop priming. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.

3.3 ERECTION TOLERANCES AND SURVEY

- A. Plumb, level, and align individual pieces in accordance with the requirements of the "AISC Code of Standard Practice for Steel Buildings and Bridges" and Section 01 71 00, "Construction Tolerance."
- B. Field Survey: Make an accurate survey of alignments and elevations of all steel members as noted on the drawings.
 - 1. During construction of the steel frame, the Contractor shall survey the column locations and splice elevations as each column tier is erected. Submit survey reports indicating this information within 24 hours for review prior to erecting the subsequent tiers.
 - 2. Permanent benchmarks shall be established by an engineer licensed to perform the work in the jurisdiction where the project is located, employed by the Contractor in accordance with the requirements of contract documents.
 - 3. Should locations vary beyond the allowable tolerances, notify the Architect/Engineer and take necessary corrective measures and modify details and/or procedures as required and approved.

3.4 HIGH-STRENGTH BOLT INSTALLATION

- A. General: Supply and install all high-strength bolts, nuts, and washers in conformance with the requirements of the current edition of "Specification for Structural Joints Using High-Strength Bolts."
 - 1. High-strength bolts in snug-tight connections, where allowed by the drawings, shall be installed in accordance with Section 8.1, "Snug-Tightened Joints."
 - 2. All other high-strength bolts shall be installed in accordance with Section 8.2, "Pretensioned Joints and Slip-Critical Joints."
 - a. Turn-of-nut pretensioning shall be in accordance with Section 8.2.1.
 - b. Calibrated wrench pretensioning is not an acceptable pretensioning method.
 - c. Twist-off-type tension-control bolt pretensioning shall be in accordance with Section 8.2.3. Tension control bolts shall be supplied and installed in accordance with the manufacturer's written procedures.
 - d. Direct-tension-indicator pretensioning shall be in accordance with Section 8.2.4. Direct tension indicators shall be supplied and installed in accordance with the manufacturer's written procedures.

END OF SECTION

SECTION 053100 – STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Features:

- 1. Steel Roof Deck
- 2. Composite Steel Deck
- 3. Support Framing
- 4. Connections
- 5. Accessories

- B. Related Sections:

- 1. 013300 – Submittal Procedures
- 2. 014500 – Structural Testing, Inspection, and Quality Assurance
- 3. 033000 – Cast-in-Place Concrete
- 4. 051200 – Structural Steel Framing
- 5. 078100 – Applied Fireproofing

1.3 REFERENCE STANDARDS

- A. General: Comply with the provisions of the latest versions of the publications listed below except as otherwise shown or specified.

- B. American Iron and Steel Institute (AISI):

- 1. AISI Specification for the Design of Cold-Formed Steel Structural Members

- C. American Society for Testing and Materials (ASTM):

- 1. ASTM A36 Standard Specification for Carbon Structural Steel
- 2. ASTM A108 Standard Specification for Steel Bar, Carbon, and Alloy, Cold-Finished
- 3. ASTM A653 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- 4. ASTM A924 General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process

- 5. ASTM A1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

D. American Welding Society (AWS):

- 1. AWS D1.1 Structural Welding Code - Steel
- 2. AWS D1.3 Structural Welding Code - Sheet Steel

E. Steel Deck Institute (SDI):

- 1. SDI Design Manual for Composite Decks, Floor Decks, and Roof Decks

F. Underwriters' Laboratories (UL) Fire Resistance Manual

G. International Code Council, Evaluation Services (ICC-ES): Evaluation Reports

H. International Association of Plumbing and Mechanical Officials: Uniform Evaluation Service (IAPMO-UES)

1.4 QUALITY ASSURANCE

- A. Qualification of Erector/Installer: Must have a minimum of 5 years' experience in the installation and/or erection of steel decking and accessories.
- B. All deck material and connections are to have current ICC-ES (or IAPMO- ES equivalent) Reports.
- C. Each welder performing work on this project shall be qualified in accordance with the American Welding Society before commencement of welding on this project.
- D. Unless otherwise noted, the materials of this Section are used as part of an assembly in which fire-resistive construction ratings are required. Demonstrate rated approval by Underwriter's Laboratories, Inc., and the governmental agencies having jurisdiction.
- E. See Section 01 45 00, "Structural Testing, Inspection, and Quality Assurance," for testing and inspection.
- F. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- G. Pre-Construction Conference: Schedule a job conference to review the Structural Documents prior to development of shop drawings. The conference shall be attended by all pertinent parties, which at a minimum is to include the Fabricator, Erector, Contractor, Owner's Testing

Agency, and Structural Engineer.

1.5 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00, "Submittal Procedures."
- B. Shop Drawings: Clearly indicate the following:
 - 1. Deck layout and orientation, type and gage, framing and supports, and unit dimensions and sections
 - 2. Size and location of holes and openings through deck
 - 3. Edge condition details and locations, including type and locations of all closures
 - 4. Additional deck support framing where required
 - 5. Types of welds and weld patterns, including weld washer requirements
 - 6. Types of connection fasteners and locations
 - 7. Location and patterns for button punching
 - 8. Layout of steel shear connector studs
 - 9. Shoring locations, if required
- C. Manufacturer's Product Data: Clearly indicate all technical information that specifies full compliance with requirements of this Section and contract documents, including manufacturer's published installation recommendations.
- D. Copies of each welder's qualification records shall be made available to the Architect for inspection.
- E. Mill Test Reports: Submit mill test reports.
- F. Submit ICC-ES (or IAPMO-ES equivalent) Report confirming compliance of steel deck with regulatory fire-resistance requirements.
- G. Environmental Product Declarations (EPDs): For steel decking types, submit product-specific Type III EPDs conforming to ISO 14025 and ISO 21930 including Life Cycle Assessment Modules A1-A3 which at a minimum must include Global Warming Potential (GWP). Submit EPDs for a minimum of 90 percent by weight of all decking used in the project.
- H. Recycled Content: For LEED v4 documentation and points, submit documentation of the materials' percent recycled content compared to totals, measured by weight or volume.
- I. Bill of Materials: Submit decking weight per element type and grade as outlined in table below prior to start of construction and at completion of construction based on material delivered to project site.

DECK TYPE	SPEC, GRADE (KSI)	GAGE	WEIGHT (US Ton or metric tonne)	GWP (kg CO ₂ eq/ metric tonne)
W3-36 COMPOSITE	ASTM A653, Gr 50			
PLB-36 ROOF	ASTM A653, Gr 50			

NOTES:

1. SUPPLIER TO SUBMIT TABLE USING PROJECT-SPECIFIC INFORMATION.
2. SUPPLIER TO REPORT ANY ASSUMPTIONS AND ALLOWANCES INCLUDED IN AMOUNTS.

1.6 HANDLING AND STORAGE

- A. Handling: Handle and stack all materials carefully in order to prevent deformation or damage. During unloading and hoisting, extra care shall be given to prevent damage to the ends and sides. Decking shall not be placed in direct contact with the ground. Store deck at a slope to prevent water from ponding. Where the underside of deck is architecturally exposed, it shall be free from visual defects such as scratches, dents, flame cut edges, holes, etc. All damaged deck shall be replaced.
- B. Damaged Units: The Contractor shall replace damaged deck units that are rejected by the Owner's Testing Agency. All rejected deck shall be immediately removed from the job site.

1.7 JOB CONDITIONS

- A. General: Conform to all local, state and federal safety regulations, especially where decking is used as planking prior to welding in place. Exercise extreme care so as to prevent decking from blowing off in wind.

1.8 CONDITION OF STEEL

- A. Pre-Fireproofing Inspection: The Contractor, steel decking erector, sprayed-on fireproofing applicator, and the Owner's Testing Agency shall conduct a visual inspection of all steel decking prior to receiving fireproofing. The purpose of this inspection is to check for foreign substances on the surfaces that could impair adhesion. Any cleaning that may be necessary as a result of this inspection shall be done at no additional cost to the Owner.
 1. All steel decking shall be free of oil, dirt, or other materials that will impair bond of concrete or fireproofing.
 2. Application of the sprayed-on fireproofing will not commence until all steel surfaces have been accepted by sprayed-on fireproofing subcontractor and material manufacturer. No additional compensation shall be granted to the Contractor, steel decking erector, or fireproofing applicator should it be determined at a later date that foreign substances that were allowed to remain on the steel surfaces will have a detrimental effect in obtaining total adhesion in accordance with the fireproofing Specification Section.

1.9 REQUIREMENTS AT EDGE CONDITIONS

- A. The Contractor shall make specific provisions to provide the necessary framing materials at slab and roof edge conditions. The Contractor shall provide and install all gage metal edge closures where required by the plans and specification and shall coordinate shoring requirements at composite slab edges. The Contractor shall provide and install all structural steel bent plate edge closures or structural steel edge materials and any corresponding bracing or shoring where required by the plans and specifications.
- B. At edge closures, provide necessary modifications to the edge closure to ensure that shear connector studs can be properly connected to the structural framing. Where possible, weld through the edge closure. Where this is not possible or where an inadequate weld occurs, cut the edge plate at each stud and connect the stud directly to the framing.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Galvanized Composite Steel Deck:

- 1. Material: Composite floor deck shall be galvanized steel conforming to ASTM A653 Grade 33 Fy (min) = 33,000 psi with a G60 coating of zinc prior to being formed. Furnish decking of depth and profile as indicated on the drawings.
- 2. Gage of deck and minimum connections shall be determined by the Contractor based on the span conditions, unshored condition, and the superimposed loads shown on the drawings, load diagrams, and notes. Minimum gage is 20. The capacities of the deck shall be based on current ICC-ES (or IAPMO-ES equivalent) Reports.
- 3. For floor deck indicated as part of a fire rated system, furnish decking listed in the UL "Fire Resistance Directory" and bearing the UL label for the system detailed.
- 4. Fabricate composite deck units with integral embossing or raised patterns to provide mechanical bond with concrete slabs.
- 5. Furnish deck panels of lengths required to span continuously over four or more supports (three spans) unless framing does not allow for such layout.
- 6. Furnish deck panels with butted end conditions and interlocking side laps, unless otherwise noted.
- 7. Furnish deck panels with provisions for venting through the deck ("vent deck") for slabs that are to receive impervious coatings such as roofing materials or waterproof membranes.

B. Roof Deck:

- 1. Material: Steel roof deck shall be galvanized steel conforming to ASTM A653 Grade 33 Fy (min) = 33,000 psi with a minimum G60 coating of zinc prior to being formed or ASTM A611 Grade C or

- D with F_y (min) = 33,000 psi with primed and painted surfaces where specified as being painted per the Architect. Furnish decking of depth, gage, and profile as indicated in drawings with all connections as indicated in the drawings and notes.
2. For deck indicated as part of a fire rated system, furnish decking listed in the UL "Fire Resistance Directory" and bearing the UL label for the system detailed.
- C. Connections: Connections shall be as noted on the drawings. Alternate connections, when proposed, shall be determined by the Contractor based on the more stringent of the manufacturer's minimum recommendations for the plan configurations and loading or as specified in the contract documents. Connections designed by the Contractor may be made by any method recommended by the manufacturer, except that button punching of side laps shall not be allowed at roof decks unless indicated specifically as being required per the Structural Plans. Connection materials shall be as follows:
1. Welded Shear Connectors: Shall be Type B in accordance with AWS D1.1 and comply with ASTM A29, Grade 1010 or 1020; of dimensions complying with AISC specifications and the contract drawings; through deck stud welded shear connectors. Install in such a manner as to provide complete fusion between the end of the stud and structural steel base material.
 2. Mechanical Fasteners: Corrosion-resistant, low-velocity, powder- actuated or pneumatically driven carbon-steel fasteners; or self- drilling, self-threading screws.
 3. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
 4. Welding Materials: Applicable AWS D1.1 and D1.3 type required for materials being welded.
 5. Weld Washers: Provide as required per manufacturer's recommendations.
- D. Support Framing: Where necessary to provide support of the deck, additional support framing shall be provided by the Contractor per the typical details so that the deck flutes are supported with a minimum 2 inches of bearing. Where no details are provided or are not applicable, the Contractor shall design and provide secondary structural steel framing consisting of ASTM A36 steel to support the deck. The secondary framing shall satisfy the requirements of Section 05 12 00, "Structural Steel Framing."
- E. Accessories: At roof and composite floor slab conditions, the Contractor is to design and provide all accessories of types required to complete the installation of steel decking in the system shown, including edge forms, end closures, sump pans, closure strips, cover plates, etc. Finish sheet steel items to match deck. Include the following items:
1. Metal cover plates to close gaps at changes in deck direction, columns, walls, and openings; 20 gage minimum.

2. Continuous sheet metal edging at openings and concrete slab edges, 20 gage minimum or as required per plan.
 3. Sealed closures for ends of cells on single-unit decking, 20 gage minimum.
 4. Fabricate metal closure strips of 20-gage sheet steel for openings between decking and other construction. Form to provide tight fitting closures at open ends of cells or flutes, sides of decking, and between decking.
- F. Shear Connectors: Where the deck capacity is determined based on the installation of shear studs, the shear studs required on the framing plans for composite beams or other connections to structural framing shall not be considered to be effective in determining the deck capacity. Shear studs, which are in addition to those required per plan, shall be provided as required by the deck manufacturer to achieve the required deck capacity, provided these additional studs can be placed on the beam without adversely affecting the shear value of the studs that are required per plan.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 TOLERANCES

- A. Unless otherwise noted, edge materials shall be field installed to the minimum tolerances of this Section, Section 01 71 00, "Construction Tolerance," or as required for the installation of the cladding system, whichever is more stringent.
1. Edge Location: ± 1 inch from established building working lines.
 2. Edge Height: $\pm 1/8$ inch from established slab thickness

3.3 INSTALLATION

- A. General: Install decking in accordance with approved shop drawings and manufacturer's recommendations. Where steel deck is to be welded to steel framing with puddle welds or shear studs, the steel framing shall be free of dirt and debris prior to laying the steel deck. Any water in the deck's valley shall be released so it does not become entrapped between the deck and the beam. The deck shall be installed so that the bottom rib is in continuous contact with the steel framing.
- B. Accurately align and adjust steel panel units in place before permanently fastening. Provide butt end spliced, do not overlap ends of deck. Inaccuracies in alignment or level shall be brought to the

attention of the Architect and corrected by the Contractor before steel panels are finally placed.

- C. Provide proper bearing on support framing of 2-inch minimum to steel and 4-inch minimum to CMU or concrete. Where shear connector studs are used, place deck so that the stud can be placed on top of the framing. If the stud falls within the top of the flute, cut a slot through the deck and provide closure so that fresh concrete will not leak.
- D. Reinforce openings in accordance with structural framing details and manufacturer's recommended details.
- E. Install strip closures at slab edges of the thickness of slab, as required to contain poured concrete. Ensure closures are of sufficient strength to remain in place without distortion.
- F. Install closure strips and angle flashings as required to close openings between deck and walls, columns, and openings and gaps between deck, to prevent concrete leakage.
- G. Connections: After deck has been aligned, provide permanent connections to the support framing with welds, shear connector studs, screw fasteners, or powder driven fasteners as required by the manufacturer or per plan. All closures, edge forms, plates, etc. shall be securely connected to the support framing per the manufacturers recommendations and per plan.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting work. Use welding washers where recommended by deck manufacturer.
- I. Furnish shoring as required to maintain position of structures and prevent deflection beyond allowable limits. Ensure construction loads do not exceed deck carrying capacity per manufacturer.
- J. Shear Connectors: Weld shear connectors to supports through decking units in accordance with manufacturer's instructions.
 - 1. General: Shear studs may be used in lieu of 3/4-inch puddle welds. The studs shall be installed only by certified operators approved by the manufacturer and who are thoroughly familiar with the installation equipment. A copy of the operating instructions for the equipment shall be at the job site at all times. Interchanging of studs and welding equipment of different manufacturers is not permitted.
 - a. Installation, inspection, and qualification of weld base metal shall conform to the requirements of AWS D1.1.
 - b. The first two studs, at the start of each production period (the interval between start-up and shut-down of equipment) and at the start of each new welding procedure, shall be

tested by bending to an angle of 30° by striking the stud with a hammer (in lieu of the first sentence in Paragraph a of the AWS code). If failure occurs in the weld, the procedure shall be corrected and the next two studs shall be welded and tested prior to welding of any more studs.

- c. If after welding, visual inspection reveals that a sound weld or a full 360° flash has not been obtained for a particular stud, the stud shall be replaced. At Contractor's option, the weld may be repaired by AWS D1.1.
- d. Studs that show no signs of failure shall be accepted as shear connectors provided they meet the dimensional limitations of the drawings, provided no portion is less than 1 inch from a proposed concrete surface, and provided any bends or out-of-plumbness does not exceed 15°. In addition, all studs shall extend not less than 1-1/2 inches above the top of the decking. If thru-deck stud welding is not practical, provide pre-punched holes in deck.
- e. The studs shall have complete fusion to the steel beams underlying the decking. Where repairs are made by fillet welding, such welding shall be between stud and beam with removal of portions of the decking as required.
- f. Ferrules shall be removed after completion.

- 2. Do not weld shear connectors through two layers (lapped ends) of decking units.
- 3. Weld only on clean, dry deck surfaces.
- 4. Space and align shear connectors as shown or, if not shown, as recommended by manufacturer.
- 5. On steel beam supporting steel deck with concrete or cast-in-place concrete, shear studs shall be placed at a maximum spacing of at 2'-0" on center.

K. Hanging Loads: Do not hang concentrated loads exceeding 50 pounds from steel roof deck. Do not hang concentrated loads exceeding 250 pounds from composite slab on deck. Loads shall be located no closer than 5'-0" from any adjacent hanging load. See Structural Drawings for other requirements.

L. Cleaning: Prior to placement of concrete or other finish materials, the deck shall be cleaned to be free of debris and water.

3.4 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Repair galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions at cut edges or locations where coating has been damaged.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

- C. Provide protection against concrete splatter or spillage for all materials that would be adversely affected by this occurrence.

3.5 CONSTRUCTION LOADING

- A. The Contractor shall assume complete responsibility for the loading of composite floor deck due to construction loads. The Contractor shall verify when it is acceptable to place loads on the composite floor deck with the deck supplier, who shall substantiate that the slab deck will not be damaged or have a reduced capacity as a result of the proposed construction loads.
- B. The Contractor shall be responsible to repair any damage that occurs to the deck due to construction loads.

END OF SECTION

SECTION 055813 - COLUMN COVERS

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 snap-together metal column covers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for column covers.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator and anodic finisher.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing column covers similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- C. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

- D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups of typical column covers.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

PART 2 - PRODUCTS

2.1 SNAP-TOGETHER COLUMN COVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fry Reglet Corporation Reveal Vertical Joint Series KSR
 - 2. ATAS International, Inc.
 - 3. Firestone Metal Products, LLC.
 - 4. Nelson Industrial Inc.
 - 5. SAF
 - 6. Petersen Aluminum Corp.
- B. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.
 - 1. Aluminum Sheet: ASTM B209 (ASTM B209M), with not less than strength and durability properties of Alloy 5005-H34, 0.125 inch thick.
 - a. Color: to be chosen by architect from Manufacturer's full range of colors.
 - 2. Column covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
 - 3. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
 - 4. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
 - 5. Form returns at vertical and horizontal joints to provide 1/2-inch- (12-mm-) wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals 1/2 inch (12 mm) deep.
 - 6. Fabricate column covers with 1/2-inch- (12-mm-) wide reveals at horizontal joints produced by forming returns on mating ends of column cover sections. Provide snap-in metal filler strips at reveals matching reveals at vertical joints. Locate horizontal joints as indicated. Joints to be 1/2 inch deep.

7. Fabricate ceiling ring to match column covers.
8. Fabricate with calk stop/stiffener ring.

2.2 MISCELLANEOUS MATERIALS

- A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
 1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work.
- B. Backing Materials: Provided or recommended by column cover manufacturer.

2.3 FABRICATION, GENERAL

- A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.
- C. Form column covers to specified dimensions and diameters as indicated on shop drawings.
- D. Column covers shall be self-aligning with attachment clips at 18" o.c. to assure solid attachment to post structures.
- E. Form radii to achieve true and smooth curves as indicated.
- F. Provide column covers in section heights indicated on Drawings.
- G. Columns shall have no exposed fasteners unless specified.
- H. Provide additional bracing components as necessary to stiffen substructure and insure solid mid-span bracings and connections. (By others)

2.4 GENERAL FINISH REQUIREMENTS

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply anodic finishes to formed metal after fabrication unless otherwise indicated.
- D. 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.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.
 - 1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Use concealed anchorages where possible.
- C. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING AND CLEANING

- A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

- A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 061000 - ROUGH CARPENTRY

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:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking, cants, and nailers.
 - 3. Wood furring and grounds.
 - 4. Wood sleepers.
 - 5. Utility shelving.
 - 6. Plywood backing panels.
 - 7. Window and door buck engineered framing system.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 1. Wood-preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Engineered wood products.
 4. Shear panels.
 5. Power-driven fasteners.
 6. Post-installed anchors.
 7. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all rough carpentry unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.

- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
 - 1. Framing for raised platforms.
 - 2. Framing for stages.
 - 3. Concealed blocking.
 - 4. Roof construction.
 - 5. Plywood backing panels.

2.4 ENGINEERED WOOD PRODUCTS

- A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- B. Window and Door Buck Engineered Framing System:
 - 1. Basis-of-Design: PreBuck, 2555 28th St. SW: Wyoming, MI 49519 – StrandGuard TimberStrand LSL 1.30E Engineered Lumber by PreBuck Engineered Framing Systems
 - 2. Meets AWPA U1-15 for Use Category 2 (UC2).
 - 3. NAHB Research Center Green Approved.
 - 4. MDI resin, 100 percent waterproof when cured.
 - 5. Treated with zinc borate through complete cross section.
 - 6. Typical material 1-1/2 inches thick; built-up as required.
 - 7. Metal flange, 1-1/2 inch x 1-1/2 inch, 20 gauge galvanized metal, as applicable.
 - 8. Fasteners: 3-4 16D nails, minimum, each corner.
 - 9. Two continuous dovetail keyways at entire perimeter to eliminate air infiltration.
 - 10. Non-obstructive with insulated concrete forming (ICF) web.
 - 11. Unit self-aligns on wall.
 - 12. Acceptable for direct contact with concrete, non-corrosive to metals, insect and fungi resistive.
 - 13. Materials: StrandGuard TimberStrand LSL 1.30E Engineered Lumber, ICC ESR-1387.
 - a. Treatment: Zinc borate through complete cross section.
 - b. Bending Strength: 1900 psi.
 - c. Tensile Strength: 1075 psi.
 - d. Shear Strength: 150 psi.
 - e. Compression – Perpendicular to Grain: 670 psi.
 - f. Specific Gravity: 0.50 into the face, 0.42 into the edge.
 - g. R-value of 1-1/2 inch thickness: 1.86.

2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.

5. Furring.
 6. Grounds.
 7. Utility shelving.
- B. Dimension Lumber Items: Construction or No. 2 Standard, Stud, or No. 3 grade lumber of the following species:
1. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 2. Eastern softwoods; NeLMA.
- C. Utility Shelving: Lumber with 15 percent maximum moisture content of the following species and grades:
1. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. Concealed Boards: 15 percent maximum moisture content and the following species and grades:
1. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 2. Eastern softwoods; No. 2 Common grade; NeLMA.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.7 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- C. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

- H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
 - I. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
 - J. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
 - K. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
 - L. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. ICC-ES evaluation report for fastener.
 - M. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- 3.2 WOOD BLOCKING, AND NAILER INSTALLATION
- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
 - B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
 - C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring horizontally at 24 inches o.c.

3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 061600 - SHEATHING

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:
 - 1. Sheathing.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
 - 4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated plywood.
 - 2. Fire-retardant-treated plywood.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having

jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood unless otherwise indicated.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

2.5 SHEATHING

- A. Plywood Sheathing: Exterior, Structural I sheathing, FRTW where indicated.
 - 1. Span Rating: Not less than 24/0.
 - 2. Nominal Thickness: Not less than 15/32 inch.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof, parapet, and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

- E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- D. Coordinate parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Screw to cold-formed metal framing.
 - b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION

SECTION 072100 - THERMAL 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. Section Includes:
 - 1. Glass-fiber blanket.
- B. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
 - 2. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
 - 3. Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.
 - 4. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; passing ASTM E 136 for combustion characteristics.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E 84.
 3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E 84.

2.2 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.

- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
 - 2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
 - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
 - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install 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 the cavities, 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. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- 3.6 PROTECTION
- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 074113.16 - STANDING SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

- 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 includes the following:
 - 1. Steel standing-seam roof panels.
 - 2. Underlayment.
 - 3. Provide all components required for a complete metal roofing system to include metal roof panels, panel clips, trim/flashing, fascias, ridge, closures, sealants, fillers and any other required items.
- C. Related Sections include the following:
 - 1. Division 7 Section - Sheet Metal Flashing and Trim.
 - 2. Division 7 Section - Roof Accessories.
 - 3. Division 7 Section - Joint Sealants.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide manufactured roof panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.
- B. Performance Testing:
 - 1. Metal roofing systems shall be tested in accordance with Underwriters Laboratories, Inc. (UL) Test Method 580 "Tests for Uplift Resistance of Roof Assemblies," Class 90 rating.
 - 2. Metal roof panels system shall be tested in accordance with ASTM E1592-95 for negative loading. Capacity for gauge, span, or loading other than those tested may be determined by interpolating between test values only.
 - 3. Metal roofing systems shall be tested in accordance with Underwriters Laboratories, Inc. (UL) Test Method UL 2218 "Impact Resistance of Prepared Roof Covering Materials" Class 4.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.

- B. Shop Drawings: Show layouts of panels on roofs, details of edge conditions, joints, panel profiles, supports, anchorages, trim, flashings, underlayment, closures, snow guards, and special details. Distinguish between factory- and field-assembled work.
 - 1. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: Manufacturer's color charts or chips showing the full range of colors, textures, and patterns available for roof panels with factory-applied finishes.
- D. Samples for Verification: Provide sample panels 12 inches long by actual panel width, in the profile, style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other exposed panel accessories.
- E. The Installer shall meet the following minimum criteria:
 - 1. Have received training and licensing from the metal roofing manufacturer for the installation of the specified roof system.
 - 2. A letter certifying the installer as the Manufacturer's Certified Installer shall accompany the submittal package.
 - 3. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Product Test Reports: Indicate compliance of manufactured roof panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.
- G. Sample Warranties: Submit a sample copy of both weather tightness and finish warranty to insure proper liability coverage is being met.
- H. Installation Quality Control: Installation will be subject to interim and final inspections, discretionary to roof system manufacturer, by a technical field representative to inspect installation of metal roof system in accordance with manufacturer's warranty requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed metal roof panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish opening dimensions and proceed with fabricating roof panels without field measurements or allow for trimming panel units. Coordinate roof

construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.6 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Weather Tightness “no monetary limit” Warranty: Submit a written warranty, signed by manufacture, covering all system panels, insulations and system components and accessories. Warranty covers finish, materials, labor and workmanship.
- C. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal roof panels within the specified warranty period and agreeing to repair finish or replace roof panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity. Non pro-rated liability coverage.
- D. Finish Warranty Period: 20 years from date of Substantial Completion.
- E. Weather Tightness “No Monetary Limit” Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Curved Steel Roof Panels System.
 - a. Drexel Metals.
 - b. McElroy Metals, Inc.
 - c. Atas, Inc.
 - d. Dimensional Metals, Inc.
 - e. Petersen ‘Pac-Clad’.

2.2 METALS AND FINISHES

- A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Minimum Yield: 50 KSI

2. Thermal Expansion: 06.7×10^{-6} in/in/F°
3. Modulus of Elasticity: 29.0×10^6 x KSI
4. Thickness: 24 gauge, unless otherwise indicated.
5. Seam Spacing: 16 inches.
6. Standing Seam Height: 1 ½ inches.
7. Finish: Apply the KYNAR 500/HYLAR 5000 organic coating in thickness indicated. Furnish appropriate air-drying spray finish in matching color for touchup.
 - a. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight with a total minimum dry film thickness of 0.9 mil and 30 percent reflective gloss when tested according to ASTM D 523.
 - b. Durability: Provide coating field tested under normal range of weather conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 according to ASTM D 4214; and without fading in excess of 5 Hunter units.
 - c. Color: As selected by Architect from manufacturer's full color range.

2.3 ROOF PANEL ASSEMBLIES

- A. Standing-Seam Roof Panels: Factory-formed for 360 degree roll, standing-seam roof panel assembly designed for concealed mechanical attachment of panels to roof deck.
 1. Standing seam roof panels to have lap joints where indicated. Joints to be aligned with those of adjacent panels. Three roof panels per row maximum.
 2. Cleats: Mechanically seamed cleats formed from minimum 0.0250-inch-thick, stainless-steel or nylon-coated aluminum sheets.

2.4 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
 3. Products: Subject to compliance with requirements, provide W.R.Grace & Company - Grace Ice and Water Shield HT; (Basis Of Design) or comparable products of one of the following manufacturers:
 - a. Henry Company;
 - b. Firestone 'Clad-Gard' SA Metal Underlayment
 - c. Kirsch Building Products, LLC;
 - d. Metal-Fab Manufacturing, LLC;
 - e. Owens Corning;
 - f. DMI 'DynaClad Ultra HT'.

2.5 MISCELLANEOUS MATERIALS

- A. General: Provide materials and accessories required for a complete roof panel assembly and as recommended by panel manufacturer, unless otherwise indicated.
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 - 1. For steel panels, use stainless-steel fasteners for exterior applications and galvanized steel fasteners for interior applications.
 - 2. For aluminum panels, use aluminum or stainless-steel fasteners for exterior applications and aluminum or galvanized steel fasteners for interior applications.
- C. Accessories: Unless otherwise specified, provide components required for a complete roof panel assembly including trim, copings, fasciae, sills, corner units, clips, flashings, gutters, sealants, gaskets, fillers, closure strips, and similar items. Match materials and finishes of panels.
 - 1. Closure Strips: Closed-cell, self-extinguishing, expanded, cellular, rubber or cross-linked, polyolefin-foam flexible closure strips. Cut or premold to match configuration of panels. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - 2. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
 - 3. Elastomeric Joint Sealant: ASTM C 920, of base polymer, type, grade, class, and use classifications required to seal joints in panel roofing and remain weathertight. Provide sealant recommended by panel manufacturer.

2.6 FABRICATION

- A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of metal panel roofing.
 - 1. Panel Supports and Anchorage: Examine roof framing to verify that purlins, angles, channels, and other secondary structural panel support members and anchorage have been installed according to written instructions of panel manufacturer.
 - 2. Do not proceed with roof panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate metal panel roofing with rain drainage work; flashing; trim; and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.

3.3 UNDERLAYMENT INSTALLATION

- A. General: Cover entire roof sheathing area with underlayment sheets as follows:
 - 1. Cut back sheets 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply sheets to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.
 - 3. Seal seams, edges, fasteners, and penetrations with underlayment manufacturer's tape.
 - 4. Extend into jambs of openings and seal corners with tape.
- B. Do not leave roof underlayment exposed to weather elements longer than limits specified by manufacturer. If manufacturer does not specify a time limit, the maximum time limit for this exposure is two days.

3.4 PANEL INSTALLATION

- A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cutting exterior panels by torch is not permitted.
 - 2. Install panels with concealed fasteners, unless otherwise indicated.
 - 3. Install panels over solid substrate. Install 1 ply of underlayment from lower edge up, with at least 3-inch side laps and 4-inch end laps.
- B. Accessories: Install components required for a complete roof panel assembly including trim, copings, fasciae, clips, flashings, gutters, sealants, gaskets, fillers, closure strips, and similar items.
- C. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating, by applying rubberized-asphalt underlayment to each metal surface, or by other permanent separation as recommended by manufacturers of dissimilar metals.
- D. Install membrane on roof deck under metal panels, unless otherwise recommended by panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal panels. Apply from eave to ridge in shingle fashion and lap joints a minimum of 2 inches.

- E. Coat back side of metal panels with bituminous coating where it will contact wood, ferrous metal, or cementitious construction.
- F. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not otherwise indicated, types recommended by panel manufacturer.
 - 1. Seal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by panel manufacturer.
- G. Standing-Seam Roof Panel Assembly: Fasten panels to supports with concealed clip according to panel manufacturer's written instructions.
 - 1. Install clips at each support with self-drilling/self-tapping fasteners.
 - 2. At end laps of panels, install tape caulk between panels.
 - 3. Seaming: Complete seaming of panel joints by operating portable power-driven equipment of type recommended by panel manufacturer to provide a 360 degree rolled, weathertight joint.
- H. Install snow guards as per manufacturer's recommendations.
- I. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 CLEANING AND PROTECTING

- A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION

SECTION 074213.13 - PREFORMED METAL 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 DESCRIPTION OF WORK

- A. This section covers the pre-finished, pre-fabricated Architectural metal wall panel system. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings as part of this section.

1.3 SUMMARY

- A. Section Includes:
 - 1. Factory formed metal wall panels.
- B. Related work specified elsewhere
 - 1. Metal Roof Deck: Division 5 Section – Steel Decking
 - 2. Wood Framing and Decking: Division 6 Section - Rough Carpentry
 - 3. Flashing and Trim: Division 7 Section - Sheet Metal Flashing and Trim
 - 4. Coping and Gravel Stops: Division 7 Section - Roof Specialties
 - 5. Sealants: Division 7 Section - Joint Sealants

1.4 DEFINITIONS

- A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal, and accessories necessary for a complete weathertight system.

1.5 SYSTEM DESCRIPTION

- A. Material to comply with:
 - 1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

1.6 WALL PANEL SYSTEM PERFORMANCE TESTING

- A. General Performance: Metal wall panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation or other defects in construction.
- B. Panels to meet:

1. Metal Wall or Metal Soffit System shall be designed to meet applicable Local Building Code and the Soffit System shall have been tested by the Manufacturer per ASTM E-330 and have the applicable Load Tables published from this Air Bag testing for negative loads.

1.7 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 4. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
 5. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 6. Review temporary protection requirements for metal panel assembly during and after installation.
 7. Review of procedures for repair of metal panels damaged after installation.
 8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation.
- C. Provide finish samples of all colors specified.
- D. Shop drawings: Show fabrication and installation layouts of metal wall panels or metal soffit panels, details of edge conditions, panel profiles, corners, anchorages, trim, flashings, closures and accessories, and special details. Distinguish between factory and field-assembled work
- E. Coordination Drawings: Plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installer of the items involved.

1.9 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.

- D. Sample Warranties: For special warranties.

1.10 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.11 QUALITY ASSURANCE

- A. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.
- B. Sheet Metal Industry Standard: Comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) *Architectural Sheet Metal Manual*.
- C. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.

1.12 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instruction and lead time requirements to avoid construction delays.
- B. Deliver components, sheets, metal wall panels and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
- C. Unload, store and erect metal wall panels in a manner to prevent bending, warping, twisting and surface damage.
- D. Stack metal wall panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness. Do not store metal wall panels in contact with other materials that might cause staining, denting or other surface damage.
- E. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.13 PROJECT CONDITIONS

- A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal wall panel work to be performed.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.14 WARRANTIES

- A. Finish warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finish within specified warranty period.
 - 1. Exposed Panels Finish - deterioration includes the following:
 - a. Color fading more than 5 hunter units when tested according to ASTM D 2244
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214
 - c. Cracking, checking, peeling or failure of a paint to adhere to a bare metal.
 - 2. Warranty Period: 20 Years from the date of substantial completion
- B. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight condition

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer's Qualifications: All panels are to be factory formed and packaged per job requirements.
 - 1. Manufacturer shall have a minimum of fifteen (15) years experience in the factory fabrication of metal wall panels.
 - 2. Manufacturer must be certified to ISO 9001:2008 with design.
- B. Coordinate with insulation requirements as noted by Architect.
- C. Secondary framing members as required for load criteria and wind requirements.

2.2 EXPOSED-FASTENER METAL WALL PANELS

- A. Exposed-Fastener, Reverse-Rib, Metal Wall Panels: Formed with recessed, trapezoidal major valleys and intermediate stiffening valleys symmetrically spaced between major valleys; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Panel profile: Similar to existing condition
- B. Tapered-Rib, Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side

edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Exterior Finish: Siliconized polyester.
 - b. Color: As selected by Architect from manufacturer's full range.
2. Panel profile: Similar to existing condition

2.3 MATERIALS AND FINISHES

- A. Exposed Coil-Coated Finish:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- C. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.
- D. Trim: Trim shall be fabricated of the same material and finish to match the profile, and be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
- E. Accessories/Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates. Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the wall panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces, except at designed points of roof panel fixity
- F. Substrate shall be Plywood
- G. Underlayment
 1. On all surfaces to be covered with metal wall panels, furnish and install a 40 mil "Peel & Stick membrane", required as outlined by metal panel manufacturer. Membrane to be a minimum of 40 mil thickness, smooth, non-granular, by one of the following manufacturers:
 - a. W.R Grace "Ice & Water Shield"
 - b. Cetco Strongseal
 - c. Carlisle CCW WIP 300HT
 - d. Interwrap Titanium PSU
 - e. MFM Corp "Wind & Water Shield"
 - f. Polyguard Deck Guard HT of Polyglas HT
 - g. Tamko TW Tile and Metal Underlayment

H. Sealants

1. Provide two-part polysulfide class B non-sag type for vertical and horizontal joints or
2. One part polysulfide not containing pitch or phenolic extenders or
3. Exterior grade silicone sealant recommended by roofing manufacturer or
4. One part non-sag, gun grade exterior type polyurethane recommended by the roofing manufacturer.

2.4 FABRICATION

A. Panels:

1. Panels to be Factory fabricated in a controlled environment.
2. Panels to be tension leveled during roll forming process.
3. Panels to be produced in longest lengths possible, except when modular units are utilized.

B. Form all components true to shape, accurate in size, square and free from distortion or defects. Cut panels to precise lengths indicated on approved shop drawings or as required by field conditions.

C. Accessories: Factory fabricates trim and flashing components in standard 12-foot lengths.

1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
2. Fabricate wall panels as required to maintain fabrication tolerances and to withstand design loads.

D. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

E. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

F. Panels, fabrication and installation shall meet the requirements of the Metal Construction Association Preformed Metal Wall Guidelines

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine alignment of structural steel and related supports, primary and secondary roof framing, solid roof sheathing, prior to installation.
- B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.

- C. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FASTENERS

- A. Secure units to supports.
- B. Place fasteners as indicated in manufacturer's standards.

3.3 PREPARATION

- A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.4 INSTALLATION

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Compliance: Comply with manufacturer's product data, recommendations and installation instructions for substrate verification, preparation requirements and installation.
- C. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years successful experience with similar applications.
- D. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation.
- E. Provide uniform, neat seams.

- F. Fasteners: Conceal fasteners where possible in exposed work. Cover and seal fasteners and anchors for watertight and leakproof installation.
- G. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- H. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.
- I. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- J. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 - 2. 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 expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 DAMAGED MATERIAL

- A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

3.6 CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damage installed products. Clean installed products in accordance with manufacturer's instruction prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

SECTION 074213.23 - METAL COMPOSITE MATERIAL 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. Section includes MCM wall panels and column covers.

1.3 DEFINITIONS

- A. DBVR: Drained and back-ventilated rainscreen system; rainscreen system designed to drain and dry cavity entering water through drainage channels, weeps, and air ventilation.
- B. MCM: Metal composite material; cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.
- C. PER: Pressure equalized rainscreen system; rainscreen system designed for no water intrusion with equal pressure between interior system cavity and outside cladding barrier.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, MCM panel Fabricator and Installer, MCM sheet manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects MCM panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to MCM panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect MCM panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

7. Review temporary protection requirements for MCM panel assembly during and after installation.
8. Review procedures for repair of panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 1. Include fabrication and installation layouts of MCM panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
 2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of MCM panel indicated with factory-applied color finishes.
 1. Include similar Samples of trim and accessories involving color selection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
 1. MCM Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance to comparable code sections IBC 1407.14 and IBC 1703.5.
 2. MCM System Fabricator's Certified System Tests Reports: Certified system test reports showing system compliance with specific performance or third-party listing documenting compliance code section. Base performance requirements on MCM system type provided.
 - a. Wet System: Tested to AAMA 501.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For MCM panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by MCM Fabricator.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for MCM fabrication and installation.
 - 1. Build mockup of typical MCM panel assembly 4' tall x 6' wide, including corner, joints supports, attachments, and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.
- B. Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack MCM panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on MCM panels during installation.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of MCM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.11 COORDINATION

- A. Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Warranty on Panel Material: Manufacturer's standard form in which manufacturer agrees to replace MCM that fails within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace MCM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide MCM panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, panel deflection no greater than L/60 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. of wall area when tested in accordance with ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration to room side of assembly when tested for 15 minutes in accordance with ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- D. Thermal Movements: Include expansion and contraction points as needed to allow for free and noiseless thermal movements from surface temperature changes.
 - 1. Temperature Change (Range): minus 20 deg F to 175 deg F, material surfaces.
- E. Fire Propagation Characteristics: MCM wall assembly passes NFPA 285 testing.

2.2 MCM WALL PANELS (Decorative Metal Wall Panels)

- A. MCM Wall Panel Systems: Provide factory-formed and -assembled, MCM wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide 3A Composites USA Inc.; ALUCOBOND® PLUS or comparable product by one of the following:
 - a. Arconic Architectural Products (USA).
 - b. Mitsubishi Chemical Composites.

- c. Benchmark MCM façade system.
- B. Aluminum-Faced Composite Wall Panels Decorative metal wall panels: Formed with 0.020-inch- thick, coil-coated aluminum sheet facings.
 - 1. Panel Thickness: 0.157 inch.
 - 2. Core: Fire retardant.
 - 3. Exterior Finish: PVDF fluoropolymer with coats and thicknesses that comply with MCM panel manufacturer's performance and warranty requirements.
 - a. Color: As selected by Owner / Architect from manufacturer's full range.
 - 4. Peel Strength: 22.5 in-lb/in. when tested for bond integrity in accordance with ASTM D1781.
 - 5. Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with ASTM E84.
- C. Attachment Assembly Components: Formed from extruded aluminum.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide Fabricator's standard sections as required for support and alignment of MCM panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of MCM panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide 3A Composites USA Inc.; ALUCOBOND® Axcent™ Trim or comparable product by one of the following:
 - a. Arconic Architectural Products (USA).
 - b. Mitsubishi Chemical Composites.
 - c. BenchMark ACM / MCM system.
 - 2. Aluminum Trim: Formed with 0.040-inch thick, coil-coated aluminum sheet facings.
 - 3. Color: As selected by Architect / Owner from manufacturer's full range.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of MCM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

- E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM panel manufacturer.

2.4 FABRICATION

- A. General: Fabricate and finish MCM panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate MCM panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations or recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. 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 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.
- C. Aluminum Panels and Accessories:

1. PVDF Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM panel supports, and other conditions affecting performance of the Work.
 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by MCM wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by MCM wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating MCM panels to verify actual locations of penetrations relative to seam locations of MCM panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and MCM panel manufacturer's written recommendations.

3.3 MCM PANEL INSTALLATION

- A. General: Install MCM panels in accordance with Fabricator's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving MCM panels.
 2. Flash and seal MCM panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by MCM panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as MCM panel work proceeds.

6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of MCM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by MCM panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support MCM wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Panel Installation: Attach MCM wall panels to supports at locations, spacings, and with fasteners recommended by Fabricator to achieve performance requirements specified.
1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent MCM wall panels with sealant backing and sealant. Install sealant backing and sealant in accordance with requirements specified in Section 079200 "Joint Sealants."
 - a. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended in writing by Fabricator. Attach routed-and-returned flanges of wall panels to panel clips with Fabricator's standard fasteners.
 - b. Panel Installation:
 - 1) Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant in accordance with requirements specified in Section 079200 "Joint Sealants."
 - 2) Seal horizontal and vertical joints between adjacent MCM wall panels with Fabricator's standard gaskets.
 - c. Joint Sealing: Seal all joints in accordance with AAMA 501.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete MCM panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by MCM panel Fabricator; or, if not indicated, provide types recommended in writing by MCM system Fabricator.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. 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 expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

- A. Site Verifications of Conditions:
 1. Verify conditions of substrate previously installed under other Sections are acceptable for the MCM system installation. Provide documentation indicating detrimental conditions to the MCM system performance.
 2. Once conditions are verified, MCM system installation tolerances are as follows:
 - a. Shim and align MCM wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.
- B. Fabricator's Field Service: Engage a factory-authorized service representative to test and inspect completed MCM wall panel installation, including accessories.
- C. MCM wall panels will be considered defective if they do not pass inspections.
- D. Additional inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as MCM panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of MCM panel installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.
- B. After MCM panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

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- C. Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 074213.53 - METAL SOFFIT 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. Section includes metal soffit panels.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 1. Wind Loads: As indicated on Drawings.
 2. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels: Solid and Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ATAS International, Inc.
 - b. Fabral.
 - c. MBCI; a division of NCI Building Systems, L.P.
 - d. Petersen Aluminum Corporation.
 2. Material: Same material, finish, and color as metal wall panels.
 3. Panel Coverage: 12 inches, or as indicated.
 4. Panel Height: 0.875 inch.
 5. Provide fully perforated panels at 4'-0" o.c., where indicated.

2.3 LINEAR METAL SOFFIT PANELS

- A. General: Provide Solid panels formed with flush profiles, intended for exterior application in horizontal, sloping, and vertical assemblies, installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Linear Metal Soffit Panels:
 - 1. Surface Texture: Smooth
 - 2. Materials: Aluminum
 - 3. Size: 6 in x 96 in
 - 4. Edge Profile: Square with Extended Flange
 - 5. Perforation Option: Unperforated.
 - 6. Flame Spread: ASTM E 1264; Class A.
 - 7. Color: As selected by Architect from Manufacturer's Full Range
 - 8. Exposure: Exterior
 - 9. Wind: As indicated on drawings.

2.4 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. 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 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.

2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
 - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
 1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal panels.
 2. Install screw fasteners in predrilled holes.
 3. Locate and space fastenings in uniform vertical and horizontal alignment.
 4. Install flashing and trim as metal panel work proceeds.
 5. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 6. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- C. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 1. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

- D. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
 - 2. 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 expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

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:
 - 1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
 - 2. Vapor retarder.
 - 3. Roof insulation.
 - 4. Cover board.
 - 5. Walkways.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
 - 3. Section 077100 "Roof Specialties" for manufactured copings and roof edge flashings.
 - 4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. For insulation and roof system component fasteners/adhesives, include copy of SPRI's Directory of Roof Assemblies listing.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 1. Layout and thickness if insulation.
 2. Base flashings and membrane terminations.
 3. Flashing details at penetrations.
 4. Tapered insulation, thickness, and slopes.
 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and adhesive spacings and patterns for adhered roofing system.
- C. Samples for Verification: For the following products:
 1. Roof membrane and flashings of color required.
 2. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates:
 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of complying with performance requirements.
 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Evaluation Reports: For components of roofing system, from ICC-ES.
 1. Field Test Reports.
 2. Concrete internal relative humidity test reports.
 3. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- E. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
 - 1. Special warranty includes roofing membrane, base flashings, roofing accessories, roof insulation, fasteners, cover boards, and other components of membrane roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
 - 3. Warranty wind speed coverage shall be 90 mph ground wind speed (measured at 10 meters above grade). Wind speed shall be noted on warranty.

- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, vapor retarders, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings shall remain watertight.
 - 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
 - 2. Hail-Resistance Rating: MH.
- D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

- A. EPDM Sheet: ASTM D 4637/D 4637M, Type I, nonreinforced, EPDM sheet with factory-applied seam tape.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Versico Roofing Systems.
 - 2. Thickness: 60 mils, nominal.
 - 3. Exposed Face Color: Black.

4. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.
- C. Slip Sheet: Manufacturer's standard, of thickness required for application.
- D. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- E. Roof Vents: As recommended by roof membrane manufacturer.
 1. Size: Not less than 4-inch diameter.
- F. Bonding Adhesive: Manufacturer's standard.
- G. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 6-inch-wide minimum, butyl splice tape with release film.
- H. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.
- I. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.
- K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.4 VAPOR RETARDER

- A. Adhered Air and Vapor barrier – 40 mil thick composite consisting of 35-mil self adhering rubberized asphalt membrane laminated to a 5-mil UV resistant poly film with an anti-skid surface compatible with manufacturer's low rise adhesive.
 1. Install over primed deck with low-VOC, methylene chloride-free adhesive primer.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by EPDM roof membrane manufacturer, approved for use in FM Approvals' RoofNav-listed roof assemblies.

- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products.
 - c. GAF.
 - d. Johns Manville; a Berkshire Hathaway company.
 - 2. Compressive Strength: 20 psi.
 - 3. Size: 48 by 48 inches.
 - 4. Thickness:
 - a. Base Layer: 2-1/2 inches.
- C. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation.
 - 2. Minimum Thickness: 1/4 inch.
 - 3. Slope:
 - a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - a. Apply at 12" on center maximum. Coordinate with manufacturer's requirements for required spacings less than 12" o.c.
 - b. Provide primer coat compliant with manufacturer's instructions.
- C. Insulation (Coverboard):
 - 1. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C 1289, Type II, Class 4, Grade 1 and with the following characteristics:
 - a. Board Size: 48 x 96 inch.
 - b. Board Thickness: 1/2 inch.
 - c. Thermal Resistance: R-value of 2.9.
 - d. Board Edges: Square.
 - e. Manufacturers:
 - 1) Firestone Building Products Co.; : www.firestonebpco.com
 - 2) Carlisle SynTec: www.carlisle-syntec.com
 - 3) GenFlex Roofing Systems; : www.genflex.com
 - f. Substitutions: See Section 012500 - Substitution Procedures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.4 VAPOR RETARDER INSTALLATION

- A. Self-Adhering-Sheet Vapor Retarder: Prime substrate using Contact Adhesive/Primer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.
 - 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
 - 2. Seal laps by rolling.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.5 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Adhesive Attachment:
 - 1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
 - a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - c. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - d. Fill gaps exceeding 1/4 inch with insulation.
 - e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - f. Adhere base layer of insulation using Urethane Adhesive Bead. Bead spacing shall be as required for Warranty Coverage. Install adhesive bead so that the distance from the edge of the board does not exceed half the bead spacing.
 - 1) Check to ensure the substrate is clean, free of debris, and other contaminants, and dry. Adhesive cannot be applied to a wet or damp surface.
 - 2) Apply adhesive over the dry substrate area at the coverage rates indicated by the manufacturer's requirements.
 - 3) Allow adhesive to rise up approximately 1/8" and develop strings prior to setting insulation boards into adhesive.
 - 4) Walk the boards into the adhesive and roll using the 30" wide, 150 pound segmented steel roller to ensure full embedment.
 - 1. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - e. Trim insulation so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch with insulation.
 - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
 - 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
 - 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
 - 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 - 4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
 - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 ADHERED ROOFING INSTALLATION

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll membrane roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.
 - 1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
 - 2. Apply lap sealant and seal exposed edges of roofing terminations.
 - 3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.
- I. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.
 - 1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
 - 2. Apply lap sealant and seal exposed edges of roofing terminations.

- J. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- K. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- L. Adhere protection sheet over roof membrane at locations indicated.

3.8 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
 - 1. Install flexible walkways at the following locations:
 - a. Perimeter of each rooftop unit.
 - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - d. Top and bottom of each roof access ladder.
 - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - f. Locations indicated on Drawings.
 - g. As required by roof membrane manufacturer's warranty requirements.
 - 2. Provide 6-inch clearance between adjoining pads.
 - 3. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

- B. Owner will engage a qualified testing agency to perform the following tests:
 - 1. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - a. Perform tests before overlying construction is placed.
 - b. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
 - c. Flood each area for 24 hours.
 - d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
 - 1) Cost of retesting is Contractor's responsibility.
 - e. Testing agency shall prepare survey report indicating locations initial leaks, if any, and final survey report.
 - 2. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

FORM 1 - ROOFING SYSTEM DESCRIPTION

1. Location _____ 2. Bldg. Name _____
3. Bldg. No. _____ 4. Roof Area (SF) _____ 5. A/E Comm. No. _____
6. New Construction: ☐ Yes ☐ No 7. Deck Slope: _____
8. Type of Deck:
☐ Metal ☐ Wood Plank or Plywood
☐ Cast-In-Place Concrete ☐ Other _____
☐ Precast/Prestressed Concrete
9. Type of Insulation Board:
☐ Polyisocyanurate/Composite ☐ Polyisocyanurate Foam
☐ Polystyrene/Composite ☐ Polystyrene
☐ Perlite ☐ Mineral Fiber
☐ Other _____
10. Insulation Manufacturer: _____
11. Insulation Thickness: _____
12. Vapor Treatment: Total coverage ☐ Yes ☐ No
☐ No Vapor Retarder ☐ Bituminous Vapor Retarder
☐ One Way Roof Vents ☐ Laminated Kraft Paper
☐ Other _____
13. Vapor Treatment Manufacturer(s): _____
14. Roofing Type:
☐ Built-Up (Asphalt) ☐ PIB ☐ TPA
☐ Built-Up (Coal-Tar) ☐ Modified Bitumen ☐ EPDM
☐ Metal Standing-Seam ☐ CSPE ☐ PVC
☐ Shingles ☐ Other _____ ☐ TPO
15. Roofing Manufacturer: _____
16. Roofing Installer/Warrantor: _____
17. Roofing Application Method:
☐ Bitumen ☐ Fully Adhered ☐ Loose-Laid
☐ Mechanically Fastened ☐ Torched ☐ Ballasted
☐ Mechanically Fastened/Fully Adhered ☐ Other _____
18. Warranty Period: From _____ To _____
19. Warranty Serial Number: _____

20. Date Roofing Completed: _____ 21. Inspector: _____

22. Prime Contractor Name: _____
Date _____

Prime Contractor Address: _____

23. Roofing Contractor: The roofing contractor shall guarantee materials and workmanship associated with the roofing, flashings, and sheet metal work incidental to the work required under the roofing subcontract, against defect due to faulty materials or workmanship for a period of two (2) years from the date of Final Completion of the entire Project. It is understood and agreed by all parties hereto that the responsibility of the roofing contractor under this guarantee form or any contract document, shall be in accordance with the roofing contractor's limited guarantee.

Roofing Contractor

Date: _____

24. Contractor's Guarantee for Reroofing: The General Contractor shall furnish, as a minimum, a manufacturer's 25-year total system material and labor warranty / guarantee with no monetary limitations (NDL no dollar limit). The contractor shall provide a workmanship warranty agreeing to maintain the entire roof system(s) in a completely watertight condition at no cost to the Owner for two (2) years from date of final acceptance. Sheet metal flashing incidental to the roofing shall be covered under the manufacturer's warranty.

General Contractor

Date: _____

25. Owner: The undersigned named Owner for Pulaski County Parks and Recreation, agrees, from the date of Final Completion of the entire Project, to maintain the roof in accordance with the manufacturer's written requirements and also agrees to avoid damage to the roof surface by any parties under his control working or walking on the roof. The Owner recognizes his responsibility to inspect the roof semi-annually.

Owner

Date: _____

INSTRUCTIONS FOR FORM 1 (Do Not Post)

1. Location: Name of activity as shown on contract.
2. Bldg. Name: As shown on contract or as provided by Architect/Engineer.
3. Bldg. Number: As provided by Architect/Engineer.
4. Roof Area: Area in square feet of roof for which deck insulation, membrane, etc. are the same. A separate form is required if any part of roof system is different over other areas of the roof.
5. A/E Commission Number: As shown on the contract drawings.
6. Show whether or not New Construction.
7. Show deck slope.
8. Type of Deck: Check appropriate block.
9. Type of Insulation Board: Check appropriate block.
10. Show insulation manufacturer's name.
11. Show minimum thickness of installed insulation.
12. Vapor Treatment: Check appropriate blocks.
13. Show vapor treatment system manufacturer's name.
14. Roofing Type: Check appropriate block.
15. Show roofing manufacturer's name.
16. Roofing Installer's or Contractor's name.
17. Roofing Application Method: Check appropriate block.
18. Warranty Period: Insert start and end dates.
19. Warranty Serial Number: Insert serial number.
20. Show date roofing was accepted by the Owner. Warranty period begins on this date.
21. Show Inspector's name.
22. Prime Contractor Name/Address/Signature: Must be signed and dated by an official of Contracting firm.
23. Roofing Contractor: Must be signed and dated by an official of the Roofing Contractor.
24. General Contractor: Must be signed and dated by the General Contractor.
25. Owner: Must be signed and dated by the Owner.

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The work to be performed under this section of the specifications comprises the furnishing of all labor and materials and the completion of all work of this section as shown on the drawings and/or herein specified.
- B. In general, the work included under this section consists of, but is not limited to, the following:
 - 1. Flashing.
 - 2. Exposed trim.

1.3 RELATED WORK

- A. In general, the following related work is included in other sections of the specifications:
 - 1. Division 7 Section "Roof Specialties."
 - 2. Division 7 Section "Joint Sealants" for elastomeric sealants.
 - 3. Division 7 Roofing Sections for flashing and roofing accessories installed integral as part of roofing-system work.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 specification sections.
- B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.
- C. Samples of sheet metal flashing trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
 - 1. 8-inch-square Samples of specified sheet materials to be exposed as finished surfaces.

2. 12-inch-long Samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish.

- D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.7 PROJECT CONDITIONS

- A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:
 1. Anodized Aluminum Sheet: ASTM B 209, 5005-H14, with a minimum thickness of 0.050 inch.
 2. Factory-Painted Aluminum Sheet: ASTM B 209, 3003-H14, with a minimum thickness of 0.040 inch, unless otherwise indicated.
- B. Stainless-Steel Sheet: ASTM A 167, Type 304, soft annealed, with No. 2D finish, except where harder temper is required for forming or performance; minimum 0.0187 inch thick, unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Solder for Stainless Steel: ASTM B 32, Grade Sn60, used with an acid flux of type recommended by stainless-steel sheet manufacturer; use a noncorrosive rosin flux over tinned surfaces.
- B. Stainless-Steel Welding Rods: Type recommended by stainless-steel sheet manufacturer for type of metal sheets furnished.
- C. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

- D. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.
- E. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- F. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."
- G. Epoxy Seam Sealer: 2-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior and interior nonmoving joints, including riveted joints.
- H. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
- I. Paper Slip Sheet: 5-lb/square red rosin, sized building paper conforming to FS UU-B-790, Type I, Style 1b.
- J. Polyethylene Underlayment: ASTM D 4397, minimum 6-mil-thick black polyethylene film, resistant to decay when tested according to ASTM E 154.
- K. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.
- L. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.3 FABRICATION, GENERAL

- A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams, tin edges to be seamed, form seams, and solder.
- E. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- F. Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form

expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

- G. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- H. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
- I. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.
- J. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
 - 1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.4 SHEET METAL FABRICATIONS

- A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.
- B. Base Flashing: Fabricate from one of the following materials:
 - 1. Aluminum: 0.050 inch thick.
- C. Flashing Receivers: Fabricate from one of the following materials:
 - 1. Aluminum: 0.050 inch thick.
- D. Plumbing Vents and Support Piping: Pre-molded pipe boot flash as recommended by membrane manufacturer.

2.5 ALUMINUM FINISHES

- A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes" for finish designations and application recommendations.
- B. Class I, Clear Anodic Finish: AA-C22A41 (Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.
- C. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.
 - 1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2

- a. Color and Gloss: As selected by Architect from manufacturer's full range of choices for color and gloss.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that field measurements, surfaces, substrates, adjacent materials, supports and conditions are as required, and ready to receive Work.
- B. Report in writing to Architect/Engineer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- C. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 INSTALLATION

- A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
- B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Prein edges of sheets to be soldered to a width of 1-1/2 inches, except where pretinned surface would show in finished Work.
 1. Do not solder the following metals:
 - a. Aluminum.
 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

- E. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
 - 1. Use joint adhesive for nonmoving joints specified not be soldered.
- F. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- H. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
 - 1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
 - 2. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.
- I. Roof-Drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.
- J. Install plumbing vent flashing as recommended by the membrane manufacturer.

3.3 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION

SECTION 077100 - ROOF 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. Section Includes:
 - 1. Roof-edge specialties.
 - 2. Roof-edge drainage systems.
 - 3. Reglets and counterflashings.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications."
 - 2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 3. Section 076200 "Sheet Metal Flashing and Trim."
 - 4. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof specialties.
 - 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
 - 2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
 - 3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
 - 4. Detail termination points and assemblies, including fixed points.
 - 5. Include details of special conditions.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.

- C. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-75. Identify materials with FM Approvals' markings.
- C. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:
 - 1. Design Pressure: 35 psf.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 ROOF-EDGE SPECIALTIES

- A. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet, with a horizontal flange and vertical leg fascia terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hickman Company, W. P.
 - b. Metal-Era, Inc.
 - c. Petersen Aluminum Corporation.
 - 2. Metallic-Coated Steel Sheet Gravel Stops: Zinc-coated (galvanized) steel, nominal 0.028-inch thickness.
 - a. Surface: Smooth, flat finish.
 - b. Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 - 3. Corners: Factory mitered and continuously welded.

2.3 ROOF-EDGE DRAINAGE SYSTEMS

- A. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch

above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Aluminum Sheet: 0.040 inch thick.
 2. Gutter Profile: Style A according to SMACNA's "Architectural Sheet Metal Manual."
 3. Corners: Factory mitered and soldered.
 4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
 5. Gutter Accessories: Wire ball downspout strainer.
- B. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.040 inch thick
- C. Splash Pans: Fabricate from the following exposed metal:
1. Formed Aluminum: 0.040 inch thick.
- D. Aluminum Finish: Two-coat fluoropolymer.
1. Color: as selected by Architect from manufacturer's full range

2.4 REGLETS AND COUNTERFLASHINGS

- A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.028-inch thickness.
 2. Corners: Factory mitered and continuously welded.
 3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
- B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.028-inch thickness.
- C. Accessories:
1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
 2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- D. Zinc-Coated Steel Finish: Two-coat fluoropolymer.
1. Color: As selected by Architect from manufacturer's full range.

2.5 MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
- C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated.

2.6 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
 - 2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Metal-Fab Manufacturing, LLC; MetShield.
 - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.
- B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

2.7 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
 - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
 - 2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
 - 3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
 - 4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 - 5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

- C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.8 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: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Coil-Coated Galvanized-Steel Sheet Finishes:
 - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

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 the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply continuously under roof-edge specialties.
 - 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.
- B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.3 INSTALLATION, GENERAL

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
 - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 - 4. Torch cutting of roof specialties is not permitted.
 - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum and stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
 - 1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
 - 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.4 ROOF-EDGE SPECIALITIES INSTALLATION

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.5 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches apart. Attach ends with rivets and solder to make watertight. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
 - 1. Align fasteners at parallel downspouts.
 - 2. Provide elbows at base of downspouts at grade to direct water away from building.
 - 3. Connect downspouts to underground drainage system indicated.
- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant.

3.6 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

- C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

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 roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 078413 - PENETRATION FIRESTOPPING

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:
 - 1. Penetrations in fire-resistance-rated walls.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to

Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
- D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hilti, Inc.
 - 2. 3M Fire Protection Products.
 - 3. Tremco, Inc.; Tremco Fire Protection Systems Group.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Fire-resistance-rated walls include fire-barrier walls.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Collars.
 - 3. Steel sleeves.

2.3 FILL MATERIALS

- A. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- B. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- C. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3.4 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.5 PENETRATION FIRESTOPPING SCHEDULE

- A. Firestopping with No Penetrating Items:

1. UL-Classified Systems: W-J- W-L- 0001-0999.
 2. F-Rating: 1 hour or 2 hours.
 3. Type of Fill Materials: As required to achieve rating.
- B. Firestopping for Metallic Pipes, Conduit, or Tubing:
1. UL-Classified Systems: W-J- W-L- 1001-1999.
 2. F-Rating: 1 hour or 2 hours.
 3. Type of Fill Materials: As required to achieve rating.
- C. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:
1. UL-Classified Systems: W-J- W-K- W-L- 2001-2999.
 2. F-Rating: 1 hour or 2 hours.
 3. Type of Fill Materials: As required to achieve rating
- D. Firestopping for Electrical Cables:
1. UL-Classified Systems: W-J- W-K- W-L- 3001-3999.
 2. F-Rating: 1 hour or 2 hours.
 3. Type of Fill Materials: As required to achieve rating.
- E. Firestopping for Insulated Pipes:
1. UL-Classified Systems: W-J- W-L- 5001-5999.
 2. F-Rating: 1 hour or 2 hours.
 3. Type of Fill Materials: As required to achieve rating.
- F. Firestopping for Miscellaneous Electrical Penetrants:
1. UL-Classified Systems: W-L- W-J- 6001-6999.
 2. F-Rating: 1 hour or 2 hours.
 3. Type of Fill Materials: As required to achieve rating.
- G. Firestopping for Miscellaneous Mechanical Penetrants:
1. UL-Classified Systems: W-J- W-L- 7001-7999.
 2. F-Rating: 1 hour or 2 hours.
 3. Type of Fill Materials: As required to achieve rating.
- H. Firestopping for Groupings of Penetrants:
1. UL-Classified Systems: W-J- W-L- 8001-8999.
 2. F-Rating: 1 hour or 2 hours.
 3. Type of Fill Materials: As required to achieve rating.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

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:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Mildew-resistant joint sealants.
 - 4. Butyl joint sealants.
 - 5. Latex joint sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

- D. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with stone masonry substrates.
 - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 - 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; Dow Corning® 791 Silicone Weatherproofing Sealant.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2000 SilPruf.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex Sil 265 LTS.
 - d. Pecora Corporation; PCS
 - e. Sika Corporation; Joint Sealants; Sikasil WS-295

- B. Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; DOW CORNING® 999A SILICONE GLAZING SEALANT.
 - b. May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex Sil 100 GC
 - c. Pecora Corporation; Pecora 860.
 - d. Polymeric Systems, Inc; PSI-601.
 - e. Sika Corporation; Joint Sealants; Sikasil-GP.

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corp. - Construction Chemicals; MasterSeal TX 1 (Pre-2014: Sonolastic TX1)
 - b. Bostik, Inc; Chem-Calk GPS1
 - c. ER Systems; an ITW Company; Pacific Polymers Elasto-Thane 230 MP.
 - d. Pecora Corporation; Dynatrol I-XL.
 - e. Polymeric Systems, Inc; Flexiprene 1000.
 - f. Schnee-Morehead, Inc., an ITW company; Permathane SM7108.
 - g. Sika Corporation; Joint Sealants; Sikaflex Textured Sealant.
 - h. Tremco Incorporated; Dymonic.
- B. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation; Dynatrol II.

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Dow Corning Corporation; DOW CORNING® 786 SILICONE SEALANT -.
- b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
- c. May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex Sil 100 WF.
- d. Pecora Corporation; Pecora 860.
- e. Tremco Incorporated; Tremsil 200.

2.5 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bostik, Inc; Chem-Calk 300.
 - b. Pecora Corporation; BC-158.

2.6 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - b. Pecora Corporation; AC-20
 - c. Tremco Incorporated; Tremflex 834.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals, LLC, Building Systems.
 - b. Construction Foam Products, a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 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 optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.

- c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
 - 4. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.

- a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints in dimension stone cladding.
 - d. Joints in exterior insulation and finish systems.
 - e. Joints between metal panels.
 - f. Joints between different materials listed above.
 - g. Control and expansion joints in ceilings and other overhead surfaces.
 - h. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, P, 25, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 - 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.

- c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Concealed mastics.
- 1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Butyl-rubber based.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior standard steel doors and frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.

6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 7. Details of anchorages, joints, field splices, and connections.
 8. Details of accessories.
 9. Details of moldings, removable stops, and glazing.
- C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.
- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ceco Door; ASSA ABLOY.
 2. Curries Company; ASSA ABLOY.
 3. Pioneer Industries.
 4. Steelcraft; an Allegion brand.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.77 deg Btu/F x h x sq.ft. when tested according to ASTM C 518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A100/A250.8, At locations indicated in the Door and Frame Schedule.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch (16 ga).
 - d. Edge Construction: Model 2, Seamless.
 - e. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
 - 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.067 inch (14 ga).
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.
 - 3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Extra-Heavy-Duty Doors and Frames: SDI A100/A250.8, At locations indicated in the Door and Frame Schedule.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (16 ga), with minimum A40coating.
 - d. Edge Construction: Model 2, Seamless Model 3, Stile and Rail.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Manufacturer's standard Polystyrene Polyurethane Polyisocyanurate Vertical steel stiffener.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (14 ga), with minimum A40 coating.
 - b. Construction: Full profile welded.
 - 3. Exposed Finish: Prime.

2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.067 inch.
- B. Construction: Full profile welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

- C. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

2.7 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

4. Terminated Stops: Terminate stops 4 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.10 LOUVERS

- A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
- B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with SDI A250.11 NAAMM-HMMA 840.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames according to NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors.
 - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8 NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 081416 - FLUSH WOOD DOORS

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:
 - 1. Solid-core doors and transom panels with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Requirements:
 - 1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
 - 7. Fire-protection ratings for fire-rated doors.
- C. Samples for Initial Selection: For factory-finished doors.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: Program certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.

- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, 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 between 25 and 55 percent during remainder of construction period.

1.7 WARRANTY

- A. Special Warranty: 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 a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers supplying products may include, but are not limited to:
 - 1. VT Industries, Inc.
 - 2. Eggers Industries.
 - 3. Graham Wood Doors.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards WDMA I.S.1-A, "Architectural Wood Flush Doors."
 - 1. Provide labels indicating that doors comply with requirements of grades specified.
- B. WDMA I.S.1-A Performance Grade: Heavy Duty.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
 2. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 4. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- E. Particleboard-Core Doors:
1. Particleboard: ANSI A208.1, Grade LD-2.
 2. Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a. 5-inch top-rail blocking, in doors indicated to have closers.
 - b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 3. Provide doors with glued-wood-stave cores instead of particleboard cores for doors indicated to receive exit devices.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors :
1. Grade: Premium, with Grade AA faces.
 2. Species: Select red oak.
 3. Cut: Rotary cut.
 4. Match between Veneer Leaves: Book match.
 5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 6. Pair and Set Match: Provide for doors hung in same opening.
 7. Exposed Vertical and Top Edges: Same species as faces - edge Type A.
 8. Core: Particleboard.
 9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
 10. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.4 LIGHT FRAMES AND LOUVERS

- A. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.
- B. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.
1. Wood Species: Same species as door faces.

- C. Metal Louvers:
 - 1. Blade Type: Vision-proof, inverted V.
 - 2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.
- D. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Activar Construction Products Group, Inc.
 - b. Allegion plc.
 - c. Anemostat Products; a Mestek company.
 - d. ASSA ABLOY.
 - e. L & L Louvers, Inc.
 - f. McGill Architectural Products.
 - 2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
 - 1. Fabricate door and transom panels with full-width, solid-lumber meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- D. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: WDMA TR-6 catalyzed polyurethane.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Effect: Filled finish.
 - 5. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 - b. 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

2. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
 - D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
 - E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- 3.3 ADJUSTING
- A. Operation: Rehang or replace doors that do not swing or operate freely.
 - B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083323 - OVERHEAD COILING DOORS

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:
 - 1. Insulated service doors.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.
 - 2. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for finish painting of factory-primed doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include description of automatic-closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 OVERHEAD COILING DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cornell.
 - b. Lawrence Roll-Up Doors, Inc.
 - c. Overhead Door Corporation.
 - d. Raynor.
 - e. Wayne-Dalton Corp.
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.

- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: Flat profile slats of 1-7/8-inch center-to-center height.
- E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- F. Hood: Galvanized steel.
 - 1. Shape: Square.
 - 2. Mounting: Face of wall.
- G. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: Locking Device Assembly. Prep for Mortise cylinder
- H. Electric Door Operator:
 - 1. Usage Classification: Standard Duty, up to 25 cycles per hour and up to 90 cycles per day.
 - 2. Operator Location: Front of Hood
 - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed.
 - 4. Motor Exposure: Interior
 - 5. Motor Electrical Characteristics: ½ hp, or as required by manufacturer based on indicated curtain size.
 - 6. Voltage: 115 V ac, single phase, 60 Hz.
 - 7. Emergency Manual Operation: Push-up.
 - 8. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
 - a. Sensor Bulb Color: Black
 - 9. Control Station(s): Mounted in Nurse's Station
 - a. Other Equipment: Portable radio-control system
 - 1) Provide two remotes.
- I. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
 - 2. Interior Curtain-Slat Facing: Finish as selected by Architect from manufacturer's full range.

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
 - 2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.4 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

2.5 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: As specified in Section 087100 "Door Hardware."
 - 2. Keys: Two for each cylinder.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.6 CURTAIN ACCESSORIES

- A. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- C. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

2.7 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
 - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf.

2.9 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
 - 1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
 - 2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door

- drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
 - 3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
 - 4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
 - 5. Through-Wall Mounted: Operator is mounted on other side of wall from coil side of door.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
- 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For fire-rated doors, activation delays closing.
- 1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
- 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.
- L. Portable Radio-Control System: Consisting of two of the following per door operator:
 - 1. Three-channel universal coaxial receiver to open, close, and stop door.
 - 2. Portable control device to open and stop door may be momentary-contact type; control to close door is to be sustained- or constant-pressure type.
 - 3. Remote-antenna mounting kit.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.4 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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:
 - 1. Exterior and interior storefront framing.
 - 2. Exterior and interior manual-swing entrance doors and door-frame units.
- B. Related Sections:
 - 1. Section 087100 "Door Hardware."
 - 2. Section 088000 "Glazing."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

- C. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

- d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
- C. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
 - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

- a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.
- D. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
- F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
- G. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.38 Btu/sq. ft. x h x deg F as determined according to NFRC 100, and 0.45 Btu/sq. ft. at operable units.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 15 as determined according to NFRC 500.
- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 - c. Interior Ambient-Air Temperature: 75 deg F.

2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Corp. series 402 (T) 2" x 4 1/2" storefront framing (interior) and EFCO Corp series 403X (X Therm) 2"x 4 1/2" (exterior) or comparable product by one of the following:
 - 1. EFCO Corporation.
 - 2. Kawneer North America.
 - 3. Tubelite.
 - 4. United States Aluminum.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing accessories, from single manufacturer.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally broken.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: Center.
 - 4. Finish: High performance organic.
 - 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
 - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209.
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.

2.4 THERMAL ENTRANCE DOOR SYSTEMS

- A. Thermal Entrance Doors: Manufacturer's standard glazed thermal entrance doors for manual-swing operation.
 - 1. Door Construction: 2" minimum thickness, with minimum 0.188-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated 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 Design: As indicated.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 1. Concrete and Masonry 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.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.

- B. 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. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- E. Storefront Framing: Fabricate components for assembly using shear-block or screw spline system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Colors shall be selected from manufacturer's full range of kynar finishes.

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 the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 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 and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

- H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
 - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

END OF SECTION

SECTION 088000 - GLAZING

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:
 - 1. Glass for doors, interior borrowed lites, storefront framing, glazed and curtain walls.
 - 2. Glazing sealants and accessories.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches square.
 - 1. Laminated glass.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturers of insulating-glass units with sputter-coated, low-E coatings.
- B. Product Certificates: For glass.
- C. Product Test Reports: For insulating glass, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 5 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
 - 1. AGC Glass Company North America, Inc.
 - 2. Berkowitz, JE, LP.
 - 3. Cardinal Glass Industries.
 - 4. Cristacurva Glass.
 - 5. Dlubak Corporation.
 - 6. Gardner Glass Products, Inc.
 - 7. General Glass International.
 - 8. Glasswerks LA, Inc.
 - 9. Glaz-Tech Industries.
 - 10. Guardian Industries Corp.
 - 11. Hartung Glass Industries.
 - 12. Northwestern Industries, Inc.
 - 13. Oldcastle BuildingEnvelope.
 - 14. Pilkington North America Inc.
 - 15. PPG Industries, Inc.
 - 16. Saint-Gobain Corporation.
 - 17. Schott North America, Inc.
 - 18. Tecnoglass S. A.
 - 19. Trulite Glass & Aluminum Solutions.
 - 20. Viracon, Inc.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
 - 1. Obtain tinted glass from single source from single manufacturer.
 - 2. Obtain reflective-coated glass from single source from single manufacturer.

- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
 - 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - b. Basic Wind Speed: As indicated on Drawings.
 - c. Importance Factor: 1.0.
 - d. Exposure Category: B.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 - 2. For laminated-glass lites, properties are based on products of construction indicated.
 - 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

- C. Thickness: Where glass thickness is indicated, it is a minimum.
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890NST.
 - e. Sika Corporation U.S.; Sikasil WS-290.
 - f. Tremco Incorporated; Spectrem 1.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress

gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type TS: Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

3.9 INSULATING GLASS SCHEDULE

- A. Glass Type IS: Low-E-coated, tinted insulating glass.
 - 1. Basis-of-Design Product: Vitro Solarban.
 - 2. Overall Unit Thickness: 1 inch.
 - 3. Minimum Thickness of Each Glass Lite: 6 mm.
 - 4. Outdoor Lite: Heat-strengthened Fully tempered float glass.
 - 5. Interspace Content: Air.

6. Indoor Lite: Heat-strengthened float glass.
7. Low-E Coating: Sputtered.
8. Winter Nighttime U-Factor: 0.29 maximum.
9. Summer Daytime U-Factor: 0.27 maximum.
10. Visible Light Transmittance: 35 percent minimum.
11. Solar Heat Gain Coefficient: 0.31 maximum.
12. Safety glazing required.

END OF SECTION

SECTION 088300 - MIRRORS

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 following types of silvered flat glass mirrors:
 - 1. Tempered glass mirrors qualifying as safety glazing.
- B. Related Requirements:
 - 1. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
 - 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of mirror.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following. Substitutions may be allowed.
 - 1. Avalon Glass and Mirror Company.
 - 2. Binswanger Mirror; a division of Vitro America, Inc.
 - 3. D & W Incorporated.
 - 4. Donisi Mirror Company.
 - 5. Gardner Glass, Inc.
 - 6. Gilded Mirrors, Inc.
 - 7. Glasswerks LA, Inc.
 - 8. Guardian Industries Corp.; SunGuard.
 - 9. Head West.
 - 10. Independent Mirror Industries, Inc.
 - 11. Lenoir Mirror Company.
 - 12. National Glass Industries.
 - 13. Stroupe Mirror Co., Inc.
 - 14. Sunshine Mirror.
 - 15. Trulite Glass & Aluminum Solutions, LLC.
 - 16. Virginia Mirror Company, Inc.
 - 17. Walker Glass Co., Ltd.
- B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.
 - 1. Nominal Thickness: 6.0 mm.
- C. Safety Glazing Products: For tempered mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

- A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
 - 1. Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Andscot Company, Inc.
 - 2) Laurence, C. R. Co., Inc.
 - 3) Stylmark, Inc.
 - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Andscot Company, Inc.
 - 2) Laurence, C. R. Co., Inc.
 - 3) Stylmark, Inc.
 - 3. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

- C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

- A. Fabricate mirrors in the shop to greatest extent possible.
- B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat polished.
 - 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 - 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
- D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
 - 1. GANA Publications: "Laminated Glazing Reference Manual," "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

- B. Provide blocking and reinforcement within walls as required for proper support and attachment of mirrors.
- C. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- D. Install mirrors with mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION

SECTION 088700 - DECORATIVE ARCHITECTURAL WINDOW FILMS

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and Division 1 specification sections, apply to work of this section.

1.2 SECTION INCLUDES

- A. Architectural Window Film for installation on interior side of exterior glazing:
 - 1. Decorative Pattern: Custom-Printed per project.

1.3 RELATED SECTIONS

- A. Section 088000 - Glazing; general glazing applications to receive architectural window film.

1.4 REFERENCES

- A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.
- B. ASTM International (ASTM):
- C. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
- D. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.
- E. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
- F. NFRC 100/200 (Formerly ASTM E903) - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.

1.5 PERFORMANCE REQUIREMENTS

- A. Flammability: Surface burning characteristics when tested in accordance ASTM E 84, demonstrating film applied to glass rated Class A for Interior Use:
 - 1. Flame Spread Index: no greater than 25.
 - 2. Smoke Developed Index: no greater than 55.

1.6 SUBMITTALS

- A. Submit under provisions of Section 013300.
 - 1. Product Data: Manufacturer's current technical literature on each product to be used, including:
 - 2. Manufacturer's Data Sheets.
 - 3. Preparation instructions and recommendations.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation methods.
 - 6. Verification Samples: For each film specified, two samples representing actual film color and pattern.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
- B. Provide documentation that the adhesive used on the specified films is a Pressure Sensitive Adhesive (PSA).
- C. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
 - 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
 - 2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
 - a. Name of building.
 - b. The name and telephone number of a management contact.
 - c. Type of glass.
 - d. Type of film and/or film attachment system.
 - e. Amount of film and/or film attachment system installed.
 - f. Date of completion.
- D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Follow Manufacturer's instructions for storage and handling.
- B. Store products in manufacturer's unopened packaging until ready for installation.

- C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.9 PROJECT 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 recommended limits.

1.10 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: 3M Commercial Solutions.
- B. CoolVu, LLC
- C. Avery Dennison Graphic Solutions

2.2 ARCHITECTURAL FINISH FILMS

- A. Basis-of-Design Architectural Finish Films: 3M Crystal Glass Finishes – 7725SE-324 Frosted Crystal.
 - 1. Material Properties:
 - a. General: Glass finish field applied application to glass material as visual opaque or decorative film.
 - b. Film: Vinyl.
 - c. Decorative Pattern: Custom-Printed per project.
 - d. Adhesive: Acrylic, Pressure Sensitive, Permanent.
 - e. Liner: Silicone-coated Polyester.
 - f. Thickness (Film and Adhesive without Liner): 4.7 mils (120 microns).
 - g. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84, Class A:
 - h. Flame Spread: 25 maximum.
 - i. Smoke Developed: 450 maximum.
 - 2. Optical Performance:
 - a. Ultraviolet Transmittance (ASTM E 903): 20 percent.
 - b. Visible Light Transmittance (ASTM E 903, ASTM E308): 72 percent.
 - c. Visible Light Reflectance (ASTM E 903): 12 percent.

- d. Solar Heat Transmittance: 64 percent.
- e. Solar Heat Reflectance: 10 percent.
- f. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): 0.82.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Film Examination:

1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
2. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.
3. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
4. Commencement of installation constitutes acceptance of conditions.

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.
- C. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

3.3 INSTALLATION

A. Film Installation, General:

1. Install in accordance with manufacturer's instructions.
2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
4. Apply film to glass and lightly spray film with slip solution.
5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

8. If completing an exterior application, check with the manufacturer as to whether edge sealing is required.

3.4 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 092216 - NON-STRUCTURAL 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. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.
 - 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch.
 - b. Depth: As indicated on Drawings.
 - 2. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.025 inch.
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) MBA Building Supplies; FlatSteel Deflection Track.
 - 3) Steel Network Inc. (The); VertiClip SLD Series.
- D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.033 inch.
 - 2. Depth: As indicated on Drawings.
- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.2 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: 2-1/2 inches.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
 - 2. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 - 2. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. Direct Furring:
1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- E. Z-Furring Members:
1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Do not attach hangers to steel roof deck.
 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 092900 - GYPSUM BOARD

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:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
 - 2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size sample in 12-inch-long length for each trim accessory indicated.
- C. Samples for Initial Selection: For each type of trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Georgia-Pacific Gypsum LLC.
 - d. National Gypsum Company.
 - e. USG Corporation.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered.
- B. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Georgia-Pacific Gypsum LLC.
 - d. National Gypsum Company.
 - e. USG Corporation.

2. Thickness: 5/8 inch.
 3. Long Edges: Tapered.
- C. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Georgia-Pacific Gypsum LLC.
 - d. National Gypsum Company.
 - e. USG Corporation.
 2. Core: 5/8 inch, Type X.
 3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
 4. Long Edges: Tapered.
 5. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- D. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Georgia-Pacific Gypsum LLC.
 - d. National Gypsum Company.
 - e. USG Corporation.
 2. Core: As indicated.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation.
 - b. Custom Building Products.
 - c. James Hardie Building Products, Inc.
 - d. National Gypsum Company.
 - e. USG Corporation.
 2. Thickness: 5/8 inch.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.
 - d. Curved-Edge Cornerbead: With notched or flexible flanges.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant.
 - b. Pecora Corporation; AC-20 FTR
 - c. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - d. USG Corporation; SHEETROCK Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.

- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: As indicated on Drawings.
 - 2. Type X: As indicated on Drawings Where required for fire-resistance-rated assembly.
 - 3. Flexible Type: Apply in double layer at curved assemblies.
 - 4. Ceiling Type: Ceiling surfaces.
 - 5. Abuse-Resistant Type: As indicated on Drawings.
 - 6. Mold-Resistant Type: As indicated on Drawings.
 - 7. Acoustically Enhanced Type: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- D. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use at exposed panel edges.
 3. Curved-Edge Cornerbead: Use at curved openings.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 5: At panel surfaces exposed to view.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 093013 - CERAMIC TILING

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:
 - 1. Porcelain tile.
 - 2. Glazed wall tile.
 - 3. Stone thresholds.
 - 4. Crack isolation membrane.
 - 5. Metal edge strips.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 2. Section 092900 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
 - 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 - 2. Obtain crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Stone thresholds.
 - 2. Waterproof membrane.
 - 3. Crack isolation membrane.
 - 4. Metal edge strips.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS

- A. Ceramic Tile Type CT Floor: Hexagon Floor Tile T-1
1. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile Bee Hive Medley, or comparable product by one of the following:
 - a. American Olean Corporation.
 - b. Crossville, Inc.
 - c. Dal-Tile Corporation.
 - d. Florida Tile, Inc.
 2. Certification: Tile certified by the Porcelain Tile Certification Agency.
 3. Face Size: As Indicated on Drawings.
 4. Thickness: 3/8 inch.
 5. Face: Plain with square edges.
 6. Dynamic Coefficient of Friction: Not less than 0.42.
 7. Tile Color, Glaze, and Pattern: As indicated, and/or selected by Architect from manufacturer's full range.
 8. Grout Color: As selected by Architect from manufacturer's full range.
 9. Trim Units TB-1: Daltile Beehive color to match T-1, unless noted otherwise. Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cove: Cove, module size 3 inches x 12 inches.
 - b. External Corners for Thinset Mortar Installations: Surface bullnose, module size 3 inches x 12 inches.
 - c. Internal Corners: Cove, module size 3 inches x 12 inches.
 - d. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.4 mm) across nominal 4-inch (100-mm) dimension.
- B. Ceramic Tile Plank Floor T-2
1. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile Acreage or comparable product by one of the following:
 - a. American Olean Corporation.
 - b. Dal-Tile Corporation.
 - c. Seneca Tiles, Inc.
 2. Module Size: As indicated on drawings
 3. Thickness: 5/16 inch.
 4. Face: Plain with modified square edges or cushion edges.
 5. Finish: Semi-gloss
 6. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
 7. Grout Color: As selected by Architect from manufacturer's full range.
 8. Mounting: Factory, back mounted.
 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base for Thinset Mortar Installations: Straight, module size 4-1/4 by 4-1/4 inches.
 - b. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, module size 4-1/4 by 4-1/4 inches.

- c. External Corners for Thinset Mortar Installations: Surface bullnose, same size as adjoining flat tile.
 - d. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.
- C. Ceramic Tile Type T-3: Glazed wall tile.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile Acreage or comparable product by one of the following:
 - a. American Olean Corporation.
 - b. Dal-Tile Corporation.
 - c. Seneca Tiles, Inc.
 - 2. Module Size: As indicated on drawings
 - 3. Thickness: 5/16 inch.
 - 4. Face: Plain with modified square edges or cushion edges.
 - 5. Finish: Semi-gloss
 - 6. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
 - 7. Grout Color: As selected by Architect from manufacturer's full range.
 - 8. Mounting: Factory, back mounted.
 - 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base for Thinset Mortar Installations: Straight, module size 4-1/4 by 4-1/4 inches.
 - b. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, module size 4-1/4 by 4-1/4 inches.
 - c. External Corners for Thinset Mortar Installations: Surface bullnose, same size as adjoining flat tile.
 - d. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 - 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bostik, Inc.; Durabond D-222 Duraguard Membrane.
 - b. Custom Building Products; RedGard Waterproofing and Crack Prevention Membrane.

2.6 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02. Required for floor tile over area's that require floor slope to drain.
 - 1. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.
 - 2. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
- B. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Ardex Americas.
 - b. Bostik, Inc.
 - c. Custom Building Products.
 - d. MAPEI Corporation.
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.7 GROUT MATERIALS

- A. Water-Cleanable Epoxy Grout: ANSI A118.3.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. Boiardi Products Corporation; a QEP company.
 - c. Bonsal American; an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Merkrete Systems; Parex USA, Inc.
 - k. Southern Grouts & Mortars, Inc.
 - l. Summitville Tiles, Inc.
 - m. TEC; H. B. Fuller Construction Products Inc.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
- C. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for finishing and edge protection at wall corners; white zinc alloy exposed-edge material.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Schluter -RONDEC or comparable product by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Custom Building Products; Surfaceguard Sealer.
 - b. Jamo Inc.; Grout Sealer.
 - c. Southern Grouts & Mortars, Inc.; Grout Sealer.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with adhesives bonded mortar bed comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
 - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 1. Glazed Wall Tile: 1/16 inch.
 2. Porcelain Tile: 1/4 inch.
- F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- G. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thinset).
 2. Do not extend crack isolation membrane under thresholds set in dry-set portland cement or latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.
- H. Metal Edge Strips: Install strips at outside corner intersections of wall tile.
- I. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation CT floor: TCNA F113; thinset mortar.
 - a. Ceramic Tile Type: Porcelain floor tile.
 - b. Thinset Mortar: Latex- portland cement mortar.
 - c. Grout: Water-cleanable epoxy grout.
 - 2. Ceramic Tile Installation CT Floor: TCNA F114 and ANSI A108.1C; cement mortar bed (thickset) with cleavage membrane; epoxy grout. This method required at locations requiring positive slope to a floor drain.
 - a. Ceramic Tile Type: CT FLOOR.
 - b. Bond Coat for Cured-Bed Method: Latex- portland cement mortar.

- c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Masonry or Concrete:
 - 1. Ceramic Tile Installation CT wall: TCNA W202; thinset mortar.
 - a. Ceramic Tile Type: CT WALL.
 - b. Thinset Mortar: Latex- portland cement mortar.
 - c. Grout: High-performance unsanded grout.
- C. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W243; thinset mortar on gypsum board.
 - a. Ceramic Tile Type: CT WALL.
 - b. Thinset Mortar: Latex- portland cement mortar.
 - c. Grout: Water-cleanable epoxy grout.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Acoustical panels and exposed suspension systems for ceilings as selected and indicated on Drawings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
 - 1. Acoustical ceiling panel and supporting suspension system are to be products of the same manufacturer.

Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be

protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces 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. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA STOCK

- A. Provide to the Owner extra stock in the amount of 5% of each type of acoustical ceiling panel used on project. Deliver in manufacturer's original packaging with clear identification of product and type.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations,

provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 ACOUSTICAL PANELS AND METAL SUSPENSION SYSTEMS FOR ACOUSTICAL PANEL CEILING

A. Reference Drawings for Acoustical Panel Ceiling and Metal Suspension System selections and locations.

1. Basis Of Design: Armstrong products as indicated.
2. Equivalent acceptable products as manufactured by USG and Certainteed.

2.3 ACOUSTICAL CEILING UNITS

A. Acoustical Panels Type ACT-1

1. Acceptable Product: 'Optima' Tegular Catalog No. 3354 as manufactured by Armstrong World Industries.
2. Surface Texture: Fine
3. Composition: Fiberglass
4. Color: White
5. Size: 24 inch X 24 inch X 1 inch
6. Edge Profile: Tegular Lay-In for interface with Prelude XL 15/16" Exposed Tee.
7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton, 26
8. Sound Absorption (NRC): 0.90
9. Emissions Testing: Section 01350 Protocol, < 13.5 ppb of formaldehyde when used under typical conditions required by ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality".
10. Flame Spread: ASTM E 1264; Class A (UL)
11. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.88.
12. Dimensional Stability: HumiGuard Plus - Temperature is between 32°F (0° C) and 120°F (49° C).
13. Antimicrobial Protection: BioBlock Plus - Resistance against the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.]

B. Suspension System For ACT-1:

1. Acceptable Product: Prelude XL 15/16" Exposed Tee as manufactured by Armstrong World Industries, Inc.
2. Components: All main beams and cross tees shall be commercial quality hot-dipped galvanized steel as per ASTM A 653. Main beams and cross tees are double-web steel construction with 15/16 IN type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished aluminum in baked polyester paint. Main beams and cross tees shall have rotary stitching.
3. Structural Classification: ASTM C 635 HD.
4. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
5. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

6. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three design load, but not less than 12 gauge.
7. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated. Provide moldings with exposed flange of the same width as exposed runner.

2.4 METAL EDGE MOLDINGS AND TRIM

- A. Products: by manufacturer of Metal Suspension System.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 9. Do not attach hangers to joist bridging.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns.
1. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND 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. Section Includes:
 - 1. Vinyl base.
 - 2. Vinyl Stair Accessories
 - 3. Vinyl molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Armstrong World Industries, Inc.
 2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 3. Johnsonite; a Tarkett company.
 4. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
 1. Group: I (solid, homogeneous).
 2. Style and Location:
 - a. Style B, Cove: Provide in areas with resilient floor coverings and as indicated on drawings.
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.

- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, or, nominal 2 inches wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned. Maintain minimum section length of 18 inches where wall length permits.
- D. Tightly adhere resilient 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. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Scribe and fit to door frames, stairs, and other obstructions.
- I. Install straight and level to maximum variation of plus or minus 1/8" inch over 10 feet.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- 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.

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- D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply two minimum, or more as recommended by manufacturer, coat(s).
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 096519 - RESILIENT TILE FLOORING

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:
 - 1. Solid vinyl floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples: Full-size units of each color and pattern of floor tile required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore certification.
- C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the

Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 SOLID VINYL FLOOR TILE (LVT 1 - 3)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Interface.
 - a. Studio Set.
 - 2. Tarkett Premier Flooring.
- B. Tile Standard: ASTM F 1700.
 - 1. Class: Class III, printed film vinyl tile.
 - 2. Type: B, embossed surface.
 - 3. Wear Layer Thickness: .022 inch (0.5 mm).
 - 4. Static Load Limit: 1500 PSI.
- C. Size: As selected from manufacturers offering.
- D. Colors and Patterns: As indicated, and/or selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
 - 1. Adhesives shall comply with the following limits for VOC content:
 - a. Vinyl Composition Tile Adhesives: 50 g/L or less.
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
 2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless flooring. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. All new resilient tile flooring shall be waxed (four coats) with Simonize premium plus, 25% solids. Once flooring is cleaned and waxed, floors shall be protected with Ram Board or equivalent until Substantial Completion.

END OF SECTION

SECTION 096566 - RESILIENT ATHLETIC FLOORING

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:

- 1. Rubber athletic flooring.
 - 2. Turf athletic flooring

- B. Related Requirements:

- 1. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with resilient athletic flooring.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Show installation details and locations of the following:

- 1. Border tiles.
 - 2. Floor patterns.
 - 3. Layout, colors, widths, and dimensions of game lines and markers.
 - 4. Locations of floor inserts for athletic equipment installed through flooring.
 - 5. Seam locations for sheet flooring.

- C. Samples: For each exposed product and for each type, color, and pattern specified, 6-inch- (150-mm-) square in size and of the same thickness indicated for the Work.

- D. Samples for Initial Selection: For each type of resilient athletic flooring.

- E. Samples for Verification: For each type, color, and pattern of flooring specified, 6-inch- (150-mm-) square in size and of same thickness and material indicated for the Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For sheet vinyl flooring Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sheet Flooring: Furnish full-width rolls of not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, and pattern of flooring installed.

1.7 QUALITY ASSURANCE

- A. Sheet Vinyl Flooring Installer Qualifications: An experienced installer who has completed sheet vinyl flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- B. Store materials to prevent deterioration.
 - 1. Store tiles on flat surfaces.
 - 2. Store rolls upright.

1.9 WARRANTY

- A. Materials:
 - 1. The indoor resilient athletic surfacing shall be covered by the manufacturer against product defects for 25 years.
- B. Installation:
 - 1. The installation of the indoor resilient multipurpose surfacing shall be covered against poor workmanship and faulty installation by a two (2) year written, limited warranty provided by the contractor performing/overseeing the installation.

1.10 FIELD CONDITIONS

- A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 65 deg F (13 deg C) or more than 85 deg F (29 deg C) , in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
 2. Close spaces to traffic during flooring installation.
 3. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Install flooring after other finishing operations, including painting, have been completed.
- C. Maintain the ambient relative humidity between 40% and 60% during installation.
- D. Until Substantial Completion, maintain ambient temperatures within range recommended by Johnsonite, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

PART 2 - PRODUCTS

2.1 ROLL RUBBER FLOORING - WEIGHT ROOM AND CARDIO ROOM

- A. Provide Tarkett DropZone Speckle or comparable products of one of the following:
1. Regupol Aktivplus.
 2. Gerflor.
 3. PowerStock Plus
- B. Description: Single-layer flooring made of blended recycled rubber and EPDM rubber chips specifically designed for adhered athletic flooring applications with wood flooring design and textured surface.
- C. 20% to 30% speckle pattern
- D. Required Physical Properties:

Property	Standard	Value
Slip Resistance	ASTM D2047	>0.8
Tensile Strength	ASTM D412	>265 PSI
Abrasion Resistance	ASTM D3389 / EN 649	< 35 g (2,000 cycles)
Density	ASTM D3676	68.3 lbs./cubic foot
Flammability	-	Pass
Tear Resistance	-	Elongation at break 1.52
VOC Compliance	ASTM D5116	Passed (CA Section 1350)
Surface Texture	—	Slight
Total Thickness	—	18 mm (0.709")

Roll Length	—	15 ft.
Roll Width	—	4 ft. (± 0.75")
Weight	—	3.75 lbs. per sq.ft.

1. Color: EPDM chips found throughout the material. Colors are as selected by Architect from the indoor resilient athletic surfacing manufacturer's standard and premium color range.
2. Adhesive: As approved by the indoor resilient athletic surfacing manufacturer.

2.2 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.
 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m) , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

- D. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
 - 1. Do not install flooring until it is the same temperature as space where it is to be installed.
- E. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.
- B. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 SHEET FLOORING INSTALLATION

- A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.
- B. Lay out sheet flooring as follows:
 - 1. Maintain uniformity of flooring direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (150 mm) away from parallel joints in flooring substrates.
 - 3. Match edges of flooring for color shading at seams.
 - 4. Locate seams according to approved Shop Drawings.
- C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- D. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.
 - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.

3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing flooring installation:

1. Sweep and vacuum flooring thoroughly.
 2. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

SECTION 096766 - FLUID-APPLIED ATHLETIC FLOORING

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:
 - 1. Polyurethane flooring, fluid applied over base mats.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with fluid-applied athletic flooring.
 - 2. Section 096723 "Resinous Flooring" for polymer floor covering systems intended for other uses.

1.3 COORDINATION

- A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For flooring. Show installation details including layout, colors, widths, and dimensions of game lines and markers and locations of athletic equipment floor inserts.
- C. Samples: For each color, gloss, and texture of floor required, 12 inches square, applied to a rigid backing. Include Sample sets showing the game-line- and marker-paint colors applied to the flooring.
- D. Samples for Initial Selection: Manufacturer's color charts showing colors and glosses available for flooring and game-line and marker paints.
- E. Samples for Verification: For each color, gloss, and texture of flooring required, 12 inches square, applied to a rigid backing. Include Sample sets showing the game-line- and marker-paint colors applied to the flooring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fluid-applied athletic flooring to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is approved, trained, or certified by fluid-applied athletic flooring manufacturer.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting flooring application.
 - 1. Do not apply flooring until spaces are enclosed and weatherproof; wet-work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.
 - 2. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 65 deg F or more than 75 deg F, in spaces to receive flooring 72 hours before installation, during installation, and 72 hours after installation unless longer period is recommended in writing by manufacturer.
 - 3. After installation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 65 deg F .
 - 4. Close spaces to traffic during flooring installation.

PART 2 - PRODUCTS

2.1 FLOORING APPLIED OVER BASE MATS

- A. Manufacturers
 - 1. Basis of Design: Padenpor Gym Flooring by Abacus
 - 2. Robbins Pulasitc
- B. Description: Fluid-applied athletic flooring system consisting of resilient base mat adhered to substrate, base mat sealer, and fluid-applied polyurethane body and topcoats.
- C. Base Mat: Manufacturer's standard base mats of granulated recycled rubber in polyurethane binder.
 - 1. Thickness: 9mm.
- D. Base-Mat Adhesive: Manufacturer's standard two-component polyurethane.

- E. Base-Mat Sealer: Manufacturer's standard two-component polyurethane compound formulated for sealing base mat.
- F. Body Coat(s): Two-component, self-leveling, pigmented, polyurethane containing no rubber fillers and no mercury.
- G. Topcoat (Finish Coat): Manufacturer's standard pigmented polyurethane.
- H. Finishes:
 - 1. Color: As selected by Architect from manufacturer's full range.
 - 2. Surface Texture: Manufacturer's standard.

2.2 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
- B. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Concrete Substrates: Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners. Remove contaminants using mechanical means.
 - 2. Alkalinity Testing: Perform pH testing according to ASTM F710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
 - 3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

- b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- B. Remove substrate coatings and other substances that are incompatible with flooring system components and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- D. Treat nonmoving substrate cracks and control joints to prevent cracks from telegraphing (reflecting) through flooring, according to manufacturer's written instructions.
- E. Protect substrate voids and joints to prevent flooring resins from flowing into or leaking through them.
- F. Move flooring installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
 - 1. Do not install flooring until it is same temperature as space where it is to be installed.
- G. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- H. Protect walls, floor openings, athletic equipment inserts, electrical openings, door frames, and other obstructions during installation. Cover floor and wall areas at mixing stations.

3.3 FLOORING INSTALLATION, GENERAL

- A. Mix and apply flooring components according to manufacturer's written instructions.
 - 1. At substrate expansion, isolation, and other moving joints, install continuous joint of same width through flooring.

3.4 INSTALLATION OF DIRECT-APPLIED FLOORING

- A. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- B. Apply body coat(s) and topcoat to produce a uniform, level surface and finish.

3.5 INSTALLATION OF FLOORING APPLIED OVER BASE MATS

- A. Adhesively apply resilient base mats to substrate according to manufacturer's written instructions.
 - 1. Do not compress mats when fitting into place. Leave gap of width recommended in writing by manufacturer at butted base-mat sheets, walls, floor openings, athletic equipment inserts, electrical openings, door frames, and other obstructions.
 - 2. Roll base mats to set them into adhesive and eliminate air pockets.

3. Repair ridges at seams, loose areas, and air pockets according to manufacturer's written instructions.
- B. Apply seal coat to base mats before applying body coat(s).
- C. Smooth ridges and high spots in seal coat before applying body coat(s).
- D. Apply body coat(s) and topcoat to produce a uniform surface and finish.

3.6 GAME LINES AND MARKERS

- A. Mask flooring at game lines and markers, and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.
- B. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.

3.7 PROTECTION

- A. Close spaces to traffic for seven days after flooring installation unless manufacturer recommends longer period in writing.
- B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

SECTION 096813 - TILE CARPETING

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 modular carpet tile.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" and Section 096519 "Resilient Tile Flooring" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.

10. Transition details to other flooring materials.

- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.
- D. Samples for Initial Selection: For each type of carpet tile.
 - 1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.
- E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups at locations and in sizes shown on Drawings.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.10 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide J&J Flooring / Advance or comparable product by one of the following:
 1. Milliken & Company.

2. Mohawk Group (The); Mohawk Carpet, LLC.
3. Patcraft; a division of Shaw Industries, Inc.
4. Shaw Contract Group; a Berkshire Hathaway company.
5. Tandus; a Tarkett company.
6. Interface Mercer Street / Broome Street

B. Pattern: As indicated.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.

2.2 WALK-OFF CARPET TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Patcraft / Make It Your Way or comparable product.

1. Pattern: As Indicated on Drawings
2. Fiber Content: 100 percent nylon 6, 6.
3. Thickness: 9/32".
4. Weight: 139 oz./sq. yd.
5. Backing/Backcoating: Vinyl composite material reinforced with fiberglass with antimicrobial additives.
6. Size: 19 11/16" x 19 11/16" square
7. Applied Treatments:
 - a. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
 - 1) Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed area recommended by manufacturer, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 097200 - WALL COVERINGS

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:
 - 1. Architectural finish films for exterior façade applications
 - 2. Architectural finish films for interior surfaces exposed to view

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate veneer matching seams and termination points.
- C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches long in size.
 - 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied.
 - a. Show complete pattern repeat.
- D. Samples for Initial Selection: For each type of wall covering.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.
 - 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - 4. Installer Qualifications: Installation shall be performed by a trained and qualified installer, specialized and experienced in work required for this project.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier. Conditions including but not limited to:
 - 1. 40 degrees F to 90 degrees F (4 degrees C to 32 degrees C) maximum temperature.
 - 2. Out of sunlight.
 - 3. Clean dry area.

4. Original container.
5. Do not stack boxes over six (6) units high. Excessive weight can damage the film
6. Relative humidity below 80 percent.
7. Handle products in accordance with manufacturer's instructions.
8. Total Pre-installation Shelf Life: Apply within 2 years of date of purchase.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance:

1. Description: Faux design appearance and texture graphic film with pressure-sensitive adhesive and air release channels. Field applied application.
2. Film for interior application: Vinyl 8 mil (200 microns) thickness OR Polyolefin 7 mils (180 microns) thickness (thickness includes film and adhesive, excludes liner).
3. Film for exterior application: Vinyl 8 mil (200 microns) thickness (thickness includes film and adhesive, excludes liner).
4. Liner: Silicone-coated poly paper, 6.2 mils (157 microns).
5. Adhesive: Pressure sensitive with air release channels, as recommended by manufacturer.
6. Surface-Burning Characteristics for Interior Application: Per ASTM E84/UL-723:
 - a. Flame-Spread Index: 25 or less, or 26-75 depending on pattern.
 - b. Smoke-Developed Index: 450 or less.
7. Surface-Burning Characteristics for Exterior Application: Per ASTM E84/UL-723:
 - a. Flame-Spread Index: 26-75.
 - b. Smoke-Developed Index: 450 or less.
8. Chemical and Stain Resistance: Contaminant was in contact with the film surface and then removed using water or mild detergent. Results may vary. The following contaminants were tested: Coffee, Tea, Milk, Red Wine, Ketchup, Cooking Oil, Vinegar, Soap Solution (1%), Ammonia solution (10%), Citrate solution (10%), Ethyl Alcohol (50%).

2.2 INTERIOR VINYL WALL COVERING

- A. Basis-of-Design: 3M Di-Noc Architectural finishes or equivalent product.
- B. Description: Provide vinyl products in rolls from same production run
- C. Width: 48 inches
- D. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.3 EXTERIOR VINYL WALL COVERING

- A. Basis-of-Design: 3M Di-Noc Architectural finishes or equivalent product.
- B. Description: Provide vinyl products in rolls from same production run
- C. Width: 48 inches

- D. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Plaster: Allow plaster to cure for at least 90 days. Neutralize areas of high alkalinity. Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 3. Metals: If not factory primed, clean and apply metal primer as recommended in writing by metal-primer manufacturer and wall-covering manufacturer.
 - 4. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 5. Painted Surfaces:
 - a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
 - b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
 - 1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

SECTION 097720 - DECORATIVE FIBERGLASS REINFORCED 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. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished gypsum wallboard plus the following accessories:
 - 1. PVC trim.
 - 2. PVC wall base.
- B. Products Not Furnished or Installed under This Section:
 - 1. Gypsum substrate board specified in Section 092900 “Gypsum Board.”

1.3 REFERENCES

- A. American Society for Testing and Materials: Standard Specifications (ASTM)
 - 1. ASTM D 256 - Izod Impact Strengths (ft #/in)
 - 2. ASTM D 570 - Water Absorption (%)
 - 3. ASTM D 638 - Tensile Strengths (psi) & Tensile Modulus (psi)
 - 4. ASTM D 790 - Flexural Strengths (psi) & Flexural Modulus (psi)
 - 5. ASTM D 2583 - Barcol Hardness
 - 6. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
 - 7. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.
- C. Selection Samples: Submit manufacturer's standard color pattern selection samples representing manufacturer's full range of available colors and patterns.

- D. Samples for Verification: Submit appropriate section of panel for each finish selected indicating the color, texture, and pattern required.
 - 1. Submit complete with specified applied finish.
 - 2. For selected patterns show complete pattern repeat.
 - 3. Exposed Molding and Trim: Provide samples of each type, finish, and color.
- E. Manufacturers Material Safety Data Sheets (MSDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site (available as downloads for most Marlite's products at <http://www.marlite.com/tech-details.aspx> or by contacting Marlite at info@marlite.com).

1.5 QUALITY ASSURANCE

- A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
 - 1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
 - a. Wall Required Rating – Class A.
- B. Sanitary Standards: System components and finishes to comply with:
 - 1. United States Department of Agriculture (USDA) requirements for food preparation facilities, incidental contact.
 - 2. Food and Drug Administration (FDA) 1999 Food Code 6-101.11.
 - 3. Canadian Food Inspection Agency (CFIA) requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials factory packaged on strong pallets.
- B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (70°) for 48 hours prior to installation.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work
- B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
 - 1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.8 WARRANTY

- A. Furnish one year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. NUDO Fiber Lite Liner Panel - LP-F9
- B. Additional acceptable manufacturer and product:
 - 1. Marlite; 202 Harger Street, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668
Email: info@marlite.com www.marlite.com.
 - 2. Stabilit Glasliner AM; Glasteel 285 Industrial Drive, Moscow, TN 38057
- C. Product:
 - 1. Standard FRP.

2.2 PANELS

- A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
 - 1. Coating: Multi-layer print, primer and finish coats or applied over-layer.
 - 2. Dimensions:
 - a. Thickness: 0.090 “ (2.29mm) nominal
 - b. Width: 4'-0” (1.22 m) nominal
 - c. Length: 8'-0”, 10'-0”, 12'-0”
 - d. Color: As selected by Architect.
 - 3. Tolerance:
 - a. Length and Width: +/-1/8 “ (3.175mm)
 - b. Square - Not to exceed 1/8 “ for 8 foot (2.4m) panels or 5/32 “ (3.96mm) for 10 foot (2.4m) panels
- B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
 - 1. Flexural Strength - 1.0×10^4 psi per ASTM D 790. (7.0 kilogram-force/square millimeter)
 - 2. Flexural Modulus - 3.1×10^5 psi per ASTM D 790. (217.9 kilogram-force/square millimeter)
 - 3. Tensile Strength - 7.0×10^3 psi per ASTM D 638. (4.9 kilogram-force/square millimeter)
 - 4. Tensile Modulus - 1.6×10^5 psi per ASTM D 638. (112.5 kilogram-force/square millimeter)
 - 5. Water Absorption - 0.72% per ASTM D 570.
 - 6. Barcol Hardness (scratch resistance) of 35 55 as per ASTM D 2583.
 - 7. Izod Impact Strength of 72 ft. lbs./in ASTM D 256
- C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.
- D. Front Finish: Pebbled in accordance with preapproved sample. Color as selected by Architect from manufacturer's standard and premium color range.
 - 1. Fire Rating Class A (I).

2.3 BASE

- A. Manufacturer's Base Molding for 0.090 " (2.29mm) thick FRP Panels
 - 1. Color: As selected by Architect.
 - 2. Profiles:
 - a. M 612 FRP Base Molding, 10' length
 - b. M 651 Inside Corner
 - c. M 660 Outside Corner
 - d. M 620 LH End Cap
 - e. M 625 RH End Cap

2.4 MOLDINGS

- A. Manufacturer's PVC Trim: Thin-wall semi-rigid extruded PVC. Length: 10 ft.
 - 1. M 350 Inside Corner,
 - 2. M 360 Outside Corner,
 - 3. M 365 Division,
 - 4. M 370 Edge,
 - 5. Color: To match wall panel.
- B. Manufacturer's Outside Corner Guard:
 - 1. F 560SS Stainless Corner Guard, 10' length
 - 2. Finish: #4 brushed satin
 - 3. M 961 PVC Outside Corner Guard, color coordinate with Wall Panel.

2.5 ACCESSORIES

- A. Fasteners: Non-staining nylon drive rivets.
 - 1. Match panel colors.
 - 2. Length to suit project conditions.
- B. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
 - 1. Manufacturer's FRP Adhesive - Water- resistant, non-flammable adhesive.
 - 2. Manufacturer's Construction Adhesive - Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
 - 3. Titebond Advanced Polymer Panel Adhesive – VOC compliant, non-flammable, environmentally safe adhesive.
- C. Sealant:
 - 1. Manufacturer's Color Matching Sealant.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
- B. Repair defects prior to installation.

1. Level wall surfaces to panel manufacturer's requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

- A. Comply with manufacturer's recommended procedures and installation sequence.
- B. Cut sheets to meet supports allowing 1/8" (3 mm) clearance for every 8 foot (2.4m) of panel.
 1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
 2. Pre-drill fastener holes 1/8" (3mm) oversize with high speed drill bit.
 - a. Space at 8" (200mm) maximum on center at perimeter, approximately 1" from panel edge.
 - b. Space at in field in rows 16' (40.64cm) on center, with fasteners spaced at 12" (30.48 cm) maximum on center.
- C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
 1. Install panels with manufacturer's recommended gap for panel field and corner joints.
 - a. Adhesive trowel and application method to conform to adhesive manufacturer's recommendations.
 - b. Drive fasteners for snug fit. Fasteners are to extend through gypsum board sheets and interior rigid insulation to Insulating Concrete Formwork studs. Do not over-tighten.
- D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
 1. All moldings must provide for a minimum 1/8" (3mm) of panel expansion at joints and edges, to insure proper installation.
 2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

- A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.
- B. Refer to manufacturer's specific cleaning recommendations. Do not use abrasive cleaners.

END OF SECTION

SECTION 098400 - TECTUM ACOUSTICAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

- A. Section Includes

- 1. Cementitious wood fiber acoustical ceiling and wall panels and system

- B. Related Sections

- 1. Section 092000 – Plaster and Gypsum Board
 - 2. Section 018113 - Sustainable Design Requirements
 - 3. Section 018119 - Indoor Air Quality Requirements
 - 4. Divisions 23 - HVAC Air Distribution
 - 5. Division 26 - Electrical

- C. Alternates

- 1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and compliance with the basis of design.
 - 2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):

- 1. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - 2. Standard Test Method for Surface Burning Characteristics of Building Materials
 - 3. ASTM E 2768-11(2018) Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials
 - 4. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint

5. ASTM C 636 / C636M – 19 Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
 6. ASTM C 754 Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board
 7. ASTM E 1264 Classification for Acoustical Ceiling Products
 8. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- B. International Building Code – Current Edition as adopted by local building code authorities.
- C. ASHRAE Standard 62.1-2004, “Ventilation for Acceptable Indoor Air Quality”
- D. NFPA 70 National Electrical Code
- E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
- G. International Code Council-Evaluation Services Report - Seismic Engineer Report
1. ESR 1308 - Armstrong Suspension Systems
- H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report
1. 0244 - Armstrong Single Span Suspension System
- I. California Department of Public Health CDPH Standard Method V. 1.2 2017
- 1.4 SYSTEM DESCRIPTION
- A. 1” Tectum Finale High NRC acoustical ceiling and wall systems are manufactured from domestic cementitious wood fiber. Built-in furring pieces with factory-filled panels provide maximum sound control and install faster.
- 1.5 SUBMITTALS
- A. Product Data: Submit manufacturer's technical data for each type of Tectum® Finale™ ceiling or walls required.
- B. Samples: Minimum 6 inch x 6 inch samples of specified Tectum Finale interior panels.
- C. Shop Drawings: Layout and details of Tectum Finale interior panels show locations of items that are to be coordinated with the installation as required.
- D. Country of Origin: Submittals must be accompanied by letter, label, or certification indicating the manufacturing country of origin. Comply with Made in USA requirements as applicable for the project.

- E. Certifications: UL certifications that products face material only complies with specified requirements, including laboratory reports showing compliance with specified tests and standards. Acoustical performance, products must be tested to the A and D-20 methods.

1.6 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate UL markings.
 - 1. Surface Burning Characteristics: Tested per ASTM E 84 (face material and furring) and complying with ASTM E 1264 Classification.
- C. Acoustic wall panels, as with other architectural features located at the ceiling, may obstruct, or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems.
- D. 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.

1.7 DELIVERY, STORAGE AND HANDLING

- A. 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.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.
- D. Provide labels indicating brand name, style, size, and thickness

1.8 PROJECT / SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Do not install ceiling panels until building is closed in and HVAC system is operational.
 - 2. Locate materials onsite at least 72 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.
- B. Maintain the following conditions in areas where acoustical materials are to be installed 72 hours before, during, and after installation:

1. Relative Humidity: 25 – 85%
2. Uniform Temperature: 32 – 120 degrees F (0 – 49 degrees C)

1.9 WARRANTY

- A. Acoustic Wall Panels: Submit a written 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. Defects in materials or factory workmanship
- B. Warranty: Thirty (30) years from date of substantial completion.
- C. 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 MANUFACTURER

- A. Subject to compliance with requirements, provide acoustic wood fiber panels by one of the following:
 1. Tectum by Armstrong World Industries, Inc. (Basis of Design)
 2. Baux Wood Wool Panels
 3. Envirocoustic Wood Wool by Acoustical Surfaces
- B. Suspension System and Accessories:
 1. By wood fiber panel manufacturer's standard

2.2 ACOUSTIC WALL PANELS

- A. Acoustical Panels
 1. Surface Texture: Coarse
 2. Composition: Aspen wood fibers bonded with inorganic hydraulic cement
 3. Finish: Surface appearance shall be consistent from panel to panel. Factory-applied latex paint with Sodium Silicate surface coating for abuse resistance. Natural (TNA) finish is unpainted.
 4. Color: Custom color range, see interiors schedule.
 5. Size: Custom sizes, see interiors elevations.
 6. Thickness: Standard 1" facing material + 1" integral furring
 7. Edge Profile: Bevel on exterior edges not adjacent to other panels.
 8. Noise Reduction Coefficient (NRC) ASTM C 423: D-20 Mounting – 0.95
 9. UL Classified Flame Spread: ASTM E 1264; Class A. Product must be able to meet this criteria after being painted six (6) times.

10. Light Reflectance (LR) ASTM E 1477
11. Dimensional Stability / Mold Resistance: HumiGuard Plus and no significant mold growth when tested by ASTM D 3273

2.3 METAL SUSPENSION SYSTEMS

A. Panel Accessories:

1. #8 x 3" Painted Head – Sharp Point Screw (Item 8187L30TNA); Qty/Ctn: 1000
2. #8 x 3" Painted Head – Drill Point Screw (Item 8188L30TNA); Qty/Ctn: 1000
3. 3-1/4" Painted Head – CMU Screw (Item 8189L32TNA); Qty/Ctn: 500

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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 and/or wall area and establish layout of acoustical units. Coordinate panel layout with mechanical and electrical fixtures.
- B. 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

- A. Install Tectum Finale Ceiling and Wall panels in accordance with manufacturer's installation instructions. See armstrongceilings.com/tectum for more information.
- B. For high humidity installations, use 3/4" pressure treated wood furring strips to maintain an air gap between structure and back of the Tectum Finale panels.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken Tectum Finale 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 Tectum® Finale Ceiling/Wall Panels that cannot be successfully cleaned and/or repaired. Replace with attic stock or new product to eliminate evidence of damage.

C. Cleaning and Disinfecting Guidelines

1. Tectum Finale Panels are part of the Armstrong World Industries CleanAssure™ Family of Products. The Clean Assure family of products includes panels, suspension systems, and trim that can be disinfected using CDC recommended and EPA-approved disinfectants. Due to the potential impact on the finish, please follow the specific guidance below:
 - a. It is recommended that only clear cleaners be used, as dyed liquids can permanently discolor the finish of the ceiling tiles.
 - b. Cleaning is only recommended for the finished face of the board.
 - c. The panels should never be soaked in water or other liquids, as this can have an adverse effect on board integrity. Use the safety recommendations for gloves and eye protection that are given by the manufacturer of the cleaner and cleaning equipment.
2. Tectum Finale panels have been tested using the “Fog” disinfectant method; using Diversey™ – Morning Mist™ Neutral Disinfectant Cleaner - Diluted 2oz per gallon
3. Disinfectant Method – FOG
 - a. Use the equipment manufacturer’s instructions regarding distance from the surface, protective gear, and ventilation.
 - b. If another cleaner has been used in the fogging equipment, be sure to thoroughly clean the equipment before use to avoid potential contamination of the board surface with a non-compatible or staining cleaner.
 - c. Remove any obvious dirt before evenly applying cleaner.
 - d. Wipe dry with a clean, white microfiber cloth. Alternatively, the board may be air dried.
4. Disclaimer: Cleaning conditions and aesthetics may be impacted by additional site conditions. These instructions pertain only to the maintenance of the aesthetics and integrity of Armstrong Ceiling Solutions products. Please consult the manufacturer’s instructions and guidance regarding any cleaning product or disinfectant product for use and efficacy.

END OF SECTION

SECTION 098436.16 – ACOUSTICAL CEILING ELEMENTS

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 shop-fabricated, acoustical ceiling element panel units tested for acoustical performance, including the following:
 - 1. Acoustical Ceiling Elements ACE-1 and ACE-2
 - 2. Acoustical Ceiling Elements ACE-3 and ACE-4
 - 3. Acoustical Ceiling Elements ACE-5

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include fabric facing, panel edge, core material, and mounting indicated.
- B. Shop Drawings: For unit assembly and installation.
 - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
 - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.
 - 3. Include direction of fabric weave and pattern matching.
- C. Samples for Initial Selection: For each type of fabric facing.

1. Include Samples of hardware and accessories involving color or finish selection.

D. Samples for Verification: For the following products:

1. Fabric: Full-width by approximately 36-inch- (900-mm-) long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Panel Edge: 12-inch- (300-mm-) long Sample(s) showing each edge profile, corner, and finish.
3. Core Material: 12-inch- (300-mm-) square Sample at corner.
4. Mounting Devices: Full-size Samples.
5. Assembled Modular Panels: Two panels including joints and mounting methods.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components above ceiling units.
2. Structural members to which suspension devices will be attached.
3. Items covered by units including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 - f. Access panels.
4. Show operation of hinged and sliding components covered by or adjacent to units.

B. Product Certificates: For each type of unit.

C. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal instructions.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fabric: For each fabric, color, and pattern installed, furnish length equal to 10 percent of amount installed, but no fewer than 10 sq. yd. (9 sq. m), full width of bolt.

2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices.

1.9 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
 1. Build mockup of typical ceiling area 96 inches (2400 mm) wide by full width of ceiling. Include intersection of wall and ceiling, corners, and perimeters.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Reference Section 012500 "Substitution Procedures".
- B. Source Limitations: Obtain ceiling units specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 1. Surface-Burning Characteristics: Comply with ASTM E 84 Class A or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.3 ACOUSTICAL CEILING ELEMENTS

- A. Modular Acoustical Ceiling Element ACE-1 & ACE-2: Basis of Design: MDC Zintra Shapes Circular Shape or comparable products as indicated on Drawings.
 1. Housing Material: 100% Moisture-Resistant Polyester.
 2. Polyethylene Terephthalate (PET) Thickness: 1 inch.
 3. Flame Spread: ASTM E-84 Class A.
 4. Size, configuration, and modular spacing as indicated on Drawings.
 5. Mounting: Direct-to Strut and Adjustable Cable Suspension as per manufacturer's instructions.
 6. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
 7. Supplemental framing between roof joists is to include ceiling element manufacturer's 4-way Adjustable Cable Kit connected to supplemental framing.
 8. Installation to structure is the responsibility of the Contractor.
 9. Color: As indicated on drawings
- B. Acoustic Ceiling Elements ACE-3 & ACE-4: Basis of Design Armstrong Feltworks Open Cell Rectangle Kits or comparable products

1. Manufacturer's standard panel construction consisting of facing material stretched or laminated over front and back faces and edge-framed core and bonded or attached to edges.
2. Panel Shape: Flat.
3. Mounting: Top-edge mounted with manufacturer's standard suspension system, secured to substrate.
4. Core: Manufacturer's standard.
5. Facing Material: Manufacturer's standard.
6. Acoustical Performance: Sound absorption: 1.38 Sabins/ sq.ft., mounting according to ASTM E 795.
7. Unit sizes as indicated on Drawings.

C. Acoustical Ceiling Element ACE-5: Unlit Tapered Lay-In Acoustical Ceiling Tile

1. Basis of Design: Focal Point 'Nivo' selection as indicated on Drawings.
2. Tile dimensions:
 - a. Length: 24 inches.
 - b. Width 24 inches.
 - c. Drop Height Varies, as indicated on Drawings.
3. Installation Method: Suspended Ceiling Grid by tile manufacturer.
4. Noise Reduction Coefficient: Apparent Value from total coverage area when tested from 200 Hz to 2500 Hz in accordance with ASTM C423. NRC Rating: 1.10 average.

2.4 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Measure each area and establish layout of panels and joints of uniform size with balanced borders at opposite edges, sizes indicated on Drawings within a given area.
- C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
 1. Square Corners: Tailor corners.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
 1. Thickness.
 2. Edge straightness.
 3. Overall length and width.
 4. Squareness from corner to corner.
 5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain as indicated on Drawings.
- D. Install ceiling units plumb, level, and true unless noted otherwise.

3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch (1.6 mm) in 48 inches (1200 mm), noncumulative.
- B. Variation from Level or Slope: Plus or minus 1/16 inch (1.6 mm).
- C. Variation of Joint Width: Not more than 1/16 inch (1.6 mm) wide from reveal line in 48 inches (1200 mm), noncumulative.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

SECTION 099113 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on exterior substrates.
 - 1. Concrete Masonry Units.
 - 2. Exterior Insulation and Finish System (EIFS).
- B. Related Requirements:
 - 1. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

3. VOC content.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers for masonry paint: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore & Co.
 2. Pratt & Lambert.
 3. Sherwin-Williams Company (The).
- B. Manufacturers for EIFS recoating: Subject to compliance with requirements, provide products by one of the following:
 1. Sto Corp.
 2. Dryvit Systems
 3. Sika USA
- C. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

- 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
 - C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
 - D. Colors: As selected by Architect from manufacturer's full range.
- 2.3 PRIMERS
- A. Exterior, Alkali-Resistant, Water-Based Primer: Pigmented, water-based primer formulated for use on alkaline surfaces, such as exterior plaster, vertical concrete, and masonry.
- 2.4 FINISH COATINGS
- A. Exterior Latex Paint, Flat: Water-based, pigmented coating; formulated for alkali, mold, microbial, and water resistance and for use on exterior surfaces, such as portland cement plaster, concrete, and primed wood.
- 2.5 EIFS REPAIR AND REFINISHING
- A. Follow manufacturers' recommended Repair and Maintenance guide for recoating.
 - B. Color: Match existing

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - 1. Paint the following work where exposed to view:
 - a. Exposed steel lintels at windows and doors.
 - b. Metal conduit.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Concrete Substrates
 - 1. Latex over Alkali-Resistant Primer System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, flat.
- B. EIFS Substrates
 - 1. Follow manufacturer's Repair and Maintenance guidelines for recoating.

END OF SECTION

SECTION 099123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete masonry units (CMU).
 - 2. Steel.
 - 3. Galvanized metal.
 - 4. Wood.
 - 5. Gypsum board.
 - 6. Plaster.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel" for shop priming of metal substrates with primers specified in this Section.
 - 2. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Pratt & Lambert.
 - 3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- C. Colors: As selected by Architect from manufacturer's full range.
 1. 30 percent of surface area will be painted with deep tones.

2.3 BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50.
- B. Primer, Latex, for Interior Wood: MPI #39.
- C. Primer Sealer, Alkyd, Interior: MPI #45.

2.5 METAL PRIMERS

- A. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.
- B. Primer, Alkyd, Quick Dry, for Metal: MPI #76.
- C. Primer, Galvanized, Water Based: MPI #134.

2.6 WATER-BASED PAINTS

- A. Latex, Interior, Flat, (Gloss Level 1): MPI #53.
- B. Latex, Interior, (Gloss Level 2): MPI #44.
- C. Latex, Interior, (Gloss Level 3): MPI #52.
- D. Latex, Interior, (Gloss Level 4): MPI #43.
- E. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
- F. Latex, Interior, Gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees): MPI #114.

2.7 SOLVENT-BASED PAINTS

- A. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.
- B. Alkyd, Interior, (Gloss Level 3): MPI #51.
- C. Alkyd, Interior, Semi-Gloss (Gloss Level 5): MPI #47.

- D. Alkyd, Interior, Gloss (Gloss Level 6): MPI #48.

2.8 TEXTURED COATING

- A. Primer for Textured Coating, Latex, Flat: As recommended in writing by topcoat manufacturer.

2.9 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Tanks that do not have factory-applied final finishes.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 - 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior:
 - 1) S-W PrepRite Block Filler, B25W25, at 75-125 sq. ft. per gal. (1.84 to 3.07 sq. m per liter).
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss:
 - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - 2. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."
- B. Metal Substrates (Aluminum, Steel, Galvanized Steel):
 - 1. Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based:
 - 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
 - c. Topcoat: Water-based acrylic, gloss:
 - 1) S-W Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - 2. Water-Based Dry-Fall System:
 - a. Top Coat: Dry-fall latex, semi-gloss:
 - 1) S-W Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-83, at 5.8 mils (0.147 mm) wet, 2.3 mils (0.058 mm) dry.
 - 3. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
- C. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, eggshell:
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - 2. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
- D. Gypsum Board Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer, latex, interior:
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss:
 - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.

2. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."

END OF SECTION

SECTION 101100 - VISUAL DISPLAY 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. Section Includes:
 - 1. Markerboards.
 - 2. Display rails.
 - 3. Tackboards.
- B. Related Requirements:
 - 1. Section 101200 "Display Cases" for tackboards within display cases.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
 - 2. Include electrical characteristics for motorized units.
- B. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
- C. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of tackboards.
- C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.10 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

2.3 MARKER BOARD (MB)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. A-1 Visual Systems.
 - 2. AARCO Products, Inc.
 - 3. ADP Lemco, Inc.
 - 4. Architectural School Products Ltd.
 - 5. Aristocrat Industries, Inc.
 - 6. Aywon.
 - 7. Bangor Cork Company, Inc.
 - 8. Best-Rite Manufacturing; a brand division of MooreCo, Inc.
 - 9. Claridge Products and Equipment, Inc.
 - 10. Egan Visual Inc.
 - 11. EverWhite; a division of Glenroy, Inc.
 - 12. Ghent Manufacturing, Inc.
 - 13. Marsh Industries, Inc.; Visual Products Group.
 - 14. Newline Products, Inc.
 - 15. Peter Pepper Products, Inc.
 - 16. Platinum Visual Systems; a division of ABC School Equipment, Inc.
- B. Display Board Assembly factory fabricated.
 - 1. Corners: Square.
 - 2. Width: As indicated on Drawings.
 - 3. Height: 4'-0".
 - 4. Mounting Method: Direct to wall.
- C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
 - 1. Color: White.
 - 2. Metal backing for use with magnets.
- D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
 - 1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
 - 2. Aluminum Finish: Clear anodic finish.
- E. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
- F. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, and continuous paper holder, designed to hold accessories.
 - 1. Size: 1 inch high by full length of visual display unit and or length indicated on Drawings.

2. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of display rail or fraction thereof.
3. Flag Holder: One for each room.
4. Aluminum Color: Match finish of visual display assembly trim.

2.4 DISPLAY RAILS (DR)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. AARCO Products, Inc.
 2. Aristocrat-Industries, Inc.
 3. Best-Rite Manufacturing; a brand division of MooreCo, Inc.
 4. Claridge Products and Equipment, Inc.
 5. EverWhite; a division of Glenroy Inc.
 6. Ghent Manufacturing, Inc.
 7. Marsh Industries, Inc.; Visual Products Group.
- B. Paper Holder Display Rail: Extruded aluminum; designed to hold paper by clamping action.
 1. Aluminum Finish: Clear anodic finish.
- C. Size: 2 inches high by length indicated on Drawings.
- D. End Stops: Plastic.

2.5 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: 4'-0" T x length indicated on drawings. Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive. Compatible with magnetic chalk trays.
 1. Face Sheet Thickness: 0.021 inch uncoated base metal thickness.
 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 3. Particleboard Core: 3/8 inch thick; with 0.015-inch- thick, aluminum sheet backing.
 4. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.6 TACKBOARD PANELS (TB)

- A. Tackboard Panels:
 1. Facing: Fabric factory laminated to 1/4-inch- thick cork sheet.
 - a. Basis-of-Design Fabric: Maharam Messenger
 - 1) Color: As Indicated on Drawings.
 2. Core: 3/8-inch-thick fiberboard.

2.7 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. High-Pressure Plastic Laminate: NEMA LD 3.
- C. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- D. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, burlap weave; weighing not less than 13 oz./sq. yd.; with surface-burning characteristics indicated.
- E. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- F. Extruded Aluminum: ASTM B 221, Alloy 6063.
- G. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display units.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive Marker boards and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- E. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
 - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.

2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- C. Factory-Fabricated marker boards: Adhere to wall surfaces with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.
- D. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.
- E. Marker Board Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.
 1. Mounting Height for Grades K through 3: 24 inches above finished floor to top of chalktray.
 2. Mounting Height for Grades 4 through 6: 28 inches above finished floor to top of chalktray.
 3. Mounting Height for Grades 7 and Higher: 36 inches above finished floor to top of chalktray.
- F. Display Rails: Install rails at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than 16 inches o.c.
 1. Mounting Height: 72 inches above finished floor to top of rail.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain marker boards.

END OF SECTION

SECTION 101423 - INTERIOR SIGNS

PART 1 - GENERAL

1.1 CONDITIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The work to be performed under this section of the specifications comprises the furnishing of all labor and materials and the completion of all work of this section as shown on the drawings and/or herein specified.
- B. In general, the work included under this section consists of, but is not limited to, the following:
 - 1. This section includes the following types of signs:
 - a. Interior identification signs.
 - b. Fire/smoke partition signs.

1.3 RELATED WORK

- A. In general, the following related work is included in other sections of the specifications:
 - 1. Division 1 Section 015000 "Temporary Facilities and Controls."
 - 2. Division 23 sections for labels, tags and nameplates for mechanical equipment.
 - 3. Division 26 sections for labels, tags and nameplates for electrical equipment.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 specification sections.
- B. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording and layout of lettering.
 - 2. Furnish full-size final proof of metal plaque.
- C. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign specified.
- D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements attached.
 - 1. Samples for initial selection of color, pattern, and texture:

- a. Cast Acrylic Sheet and Photopolymer: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

1.5 QUALITY ASSURANCE

- A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the work.
- B. Single-Source Responsibility: Provide all signs of each type required from a single manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following.
 1. Manufacturers of Building Plaque:
 - a. Sign Graphics, Inc.
 2. Manufacturers of Identification Signs:
 - a. Sign Graphics, Inc.
 3. Manufacturers of Fire/Smoke Partition Signs:
 - a. Champion America.

2.2 IDENTIFICATION SIGNS

- A. Photopolymer: An integral, one piece plate composed of a polymer face and a phenolic backing. Using camera ready artwork as a "master", a photo mechanical etching process extracts the background and leaves the graphics and braille raised. Background is cut to size, then painted on face and returns. Raised graphics are touch printed on the face, braille is not touch printed.
 1. Copy: Raised 1/32", 5/8" (h) minimum, 2" (h) maximum, all caps.
 2. Braille: Grade II, raised 1/32", remains color of faceplate.
 3. Finish: Matte or eggshell, 70% contrast between graphics color and background color.
 4. Typeface: Sans serif or simple serif.
- B. Signs: Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:
 1. Edge Condition: Square cut.
 2. Edge Color: Edge color same as background.
 3. Corner Condition: Rounded corners.
 4. Letters and numbers shall have a width to height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10 and shall be accompanied with Grade 2 Braille.
 5. Provide sign(s), 2" high x 1/8-inch thick. Approximately 20 letters or numbers per sign. Actual text as directed.
 6. Provide sign(s), 2" high x 1/8-inch thick, stating "Maximum Capacity ____". Actual text as directed.

- C. Construction: Signs located in exterior environments shall be constructed to prevent fading from the sun and to prevent delamination from action of moisture freezing and thawing.

2.3 FIRE/SMOKE PARTITION SIGNS

- A. Concealed fire walls, vertical fire separation assemble, fire partitions and smoke barriers shall be designated above the ceiling and/or the inside of all ceiling access door, which provide access to such fire rated assemblies by signage having letter no smaller than one inch in height. Such signage shall contain the wording "Fire Rated Assembly" printed on 60 mil vinyl and overcoated with layer of Tedlar and shall be provided at horizontal intervals of no more than eight feet. See drawings for location of fire rated assemblies.
- B. Contractor's Option: Field painted signage directly on fire rated substrate.

2.4 FINISHES

- A. The characters and background of signs shall be eggshell, matte, or other non-glare finish. Character and symbol color shall contrast with the background; either light characters on a dark background or dark characters on a light background. Colors shall be as selected.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that field measurements, surfaces, substrates, adjacent materials, supports and conditions are as required, and ready to receive Work.
- B. Report in writing to Architect/Engineer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- C. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
- B. Wall-Mounted Signs: Attach signs to wall surfaces using the method indicated below:
 - 1. 2 one-way screws per panel sign with anchors as required.
 - 2. Mount panel signs adjacent to latch side of door, 60 inches above finish floor to center line of sign.

3.3 CLEANING AND PROTECTION

- A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

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:
 - 1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for supports that attach and to overhead structural system.
 - 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings: For toilet compartments.
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of cutouts for compartment-mounted toilet accessories.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show locations of floor drains.
 - 5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.
- C. Samples for Initial Selection: For each type of toilet compartment material indicated.
 - 1. Include Samples of hardware and accessories involving material and color selection.
- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.
 - 1. Door Hinges: Three hinge(s) with associated fasteners.
 - 2. Latch and Keeper: Three latch(es) and keeper(s) with associated fasteners.
 - 3. Door Bumper: Three bumper(s) with associated fasteners.
 - 4. Door Pull: Three door pull(s) with associated fasteners.
 - 5. Fasteners: Ten fasteners of each size and type.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Hiney Hiders by Scranton Products or comparable product by one of the following:
 - 1. Bradley Corporation.
 - 2. General Partitions Mfg. Corp.
 - 3. Global Partitions; ASI Group.
 - 4. Scranton Products.
- B. Toilet-Enclosure Style: Overhead braced Floor anchored.
- C. Urinal-Screen Style: Floor anchored Overhead braced.

- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Color and Pattern: In each room, as indicated and/or as selected by Architect from manufacturer's full range.
 - 2. Panel Edge: Door edge to have either shiplap design or a continuous strike to eliminate visibility gaps.
 - 3. Door size: Doors to be mounted at 9" above floor finish.
- E. Pilaster Shoes: Manufacturer's standard design; stainless steel.
- F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe matching that on the pilaster.
- G. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, stainless steel.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
 - 1. Hinges: Manufacturer's minimum 0.062-inch-thick stainless-steel paired, self-closing, continuous type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through-bolts.
 - 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
 - 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
 - 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
 - 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

- B. Stainless-Steel Castings: ASTM A 743/A 743M.
- C. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at bottoms of posts. Provide shoes at posts to conceal anchorage.
- E. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

- a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

SECTION 102213 - WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Standard-duty wire mesh partitions.

1.2 DEFINITIONS

- A. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
- B. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Wire mesh partitions.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for units with factory-applied color finishes.
- D. Samples for Verification: Panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.
 - 1. Size: 12 by 12 inches.
- E. Delegated Design Submittals: For wire mesh partitions indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates:
 - 1. Welding certificates.
- B. Qualification Statements: For Installer.
- C. Delegated design engineer qualifications.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wire mesh partition hardware.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: Authorized representative who is trained and approved by manufacturer.
 - 2. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
 - a. AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inventory wire mesh partition door hardware on receipt.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. WireCrafters
- B. Acorn Wire & Iron Works
- C. Newark Wire Works
- D. Standard Wire & Steel Works

2.2 SOURCE LIMITATIONS

- A. For wire mesh products, obtain each color, grade, finish, type, and variety from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wire mesh units.
- B. Structural Performance: Wire mesh units to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft. at any location on a panel.
 - 2. Total load of 200 lbf applied uniformly over each panel.
 - 3. Concentrated load and total load need not be assumed to act concurrently.

2.4 STANDARD-DUTY WIRE MESH PARTITIONS

- A. Mesh: 0.135-inch-diameter, intermediate-crimp steel wire woven into 1-1/2-inch diamond mesh.
- B. Vertical Panel Framing: 1-1/4-by-5/8-by-0.080-inch cold-rolled, C-shaped steel channels with holes for 1/4-inch-diameter bolts not more than 12 inches o.c.
- C. Horizontal Panel Framing: 1-by-1/2-by-1/8-inch cold-rolled steel channels.
- D. Horizontal Panel Stiffeners: Two cold-rolled steel channels, 3/4 by 3/8 by 1/8 inch, bolted or riveted toe to toe through mesh; or one 1-by-1/2-by-1/8-inch cold-rolled steel channel with wire mesh woven through channel.
- E. Top Capping Bars: 2-1/4-by-1-inch cold-rolled steel channels.
- F. Posts for 90-Degree Corners: 1-1/4-by-1-1/4-by-1/8-inch steel angles or square tubes with holes for 1/4-inch-diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.
- G. Line Posts: 3-inch-by-4.1-lb or 3-1/2-by-1-1/4-by-0.127-inch steel channels; with 1/4-inch steel base plates.
- H. Three-Way Intersection Posts: 1-1/4-by-1-1/4-by-1/8-inch steel tubes or channels, with holes for 1/4-inch-diameter bolts aligned for bolting to adjacent panels.
- I. Four-Way Intersection Posts: 1-1/4-by-1-1/4-by-1/8-inch steel tubes, with holes for 1/4-inch-diameter bolts aligned for bolting to adjacent panels.
- J. Floor Shoes: Metal, not less than 2 inches high; sized to suit vertical framing, drilled for attachment to floor, and with setscrews for leveling adjustment.
- K. Finish: Shop primed for field painting unless otherwise indicated.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.5 MATERIALS

- A. Steel Wire: ASTM A510/A510M.
- B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.

- C. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513/A513M, Type 5, mandrel-drawn mechanical tubing.
- D. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.
- E. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components are zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
- F. Power-Driven Fasteners: ICC-ES AC70.
- G. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."
- H. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- I. Zinc-Rich Primer: Compatible with topcoat, complying with SSPC-Paint 20 or SSPC-Paint 29.
- J. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.6 FABRICATION

- A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.
 - 1. Fabricate wire mesh items to be readily disassembled.
 - 2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.
- B. Standard-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
 - 1. Mesh: Securely clinch mesh to framing.
 - 2. Framing: Fabricate framing with mortise-and-tenon corner construction.
 - a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
 - b. Fabricate three- and four-way intersections using manufacturer's standard connecting clips and fasteners.
 - c. Fabricate partition and door framing with slotted holes for connecting adjacent panels.
 - 3. Fabricate wire mesh partitions with 3 to 4 inches of clear space between finished floor and bottom horizontal framing.
 - 4. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

2.7 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean items of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh units unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

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 the Work.
- B. Examine floors for suitable conditions where wire mesh items will be installed.
- C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRE MESH PARTITIONS

- A. Anchor wire mesh partitions to floor with 3/8-inch-diameter, postinstalled expansion anchors at 12 inches o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
 - 1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- B. Anchor wire mesh partitions to floor with 3/8-inch-diameter, postinstalled expansion anchors at 12 inches o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
 - 1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- C. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:
 - 1. For concrete and solid masonry anchorage, use expansion anchors.

2. For hollow masonry anchorage, use toggle bolts.
 3. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
 4. For steel-framed gypsum board assemblies, use lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
 5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.
- D. Secure top capping bars to top framing channels with 1/4-inch-diameter, "U" bolts spaced not more than 28 inches o.c.
- E. Provide line posts at locations indicated or, if not indicated, as follows:
1. On each side of sliding-door openings.
 2. For partitions that are 7 to 9 ft. high, spaced at 15 to 20 ft. o.c.
 3. For partitions that are 10 to 12 ft. high, located between every other panel.
 4. For partitions that are more than 12 ft. high, located between each panel.
- F. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.
- G. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.
- H. Install doors complete with door hardware.
- I. Install service windows complete with window hardware.
- J. Weld or bolt sheet metal bases to wire mesh partitions.
- K. Bolt accessories to wire mesh partition framing.

3.3 INSTALLATION OF WIRE MESH CEILINGS

- A. Anchor wall support angle to walls at 12 inches o.c. and as follows:
1. For concrete and solid masonry anchorage, use expansion anchors.
 2. For hollow masonry anchorage, use toggle bolts.
 3. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
 4. For steel-framed gypsum board assemblies, use lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
 5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.
- B. Attach wire mesh ceiling panels to wall support angles with bolts at 12 inches o.c.
- C. Attach wire mesh ceiling panels to wire mesh partitions with slotted angles bolted to sides of ceiling panels and to top of partitions at 12 inches o.c.

- D. Attach wire mesh ceiling panels to intermediate supports as recommended by manufacturer.
- E. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

3.4 INSTALLATION OF WIRE MESH STAIRWAY PARTITIONS

- A. Anchor wire mesh stairway partitions to floor with 3/8-inch-diameter, postinstalled expansion anchors at 12 inches o.c. through floor shoes located at each post. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
 - 1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- B. Anchor angle clips supporting wire mesh stairway partitions at stairs and intermediate landings with 3/8-inch-diameter, postinstalled expansion anchors at 12 inches o.c. Weld stairway partition framing to angle clips.
 - 1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- C. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability; extend and fasten members to supporting structure.
- D. Install doors complete with door hardware.

3.5 INSTALLATION OF WIRE MESH EQUIPMENT BARRIERS

- A. Anchor wire mesh equipment barriers to floor with 3/8-inch-diameter, expansion anchors through post bases. Shim post bases as required to achieve level and plumb installation.
- B. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- C. Install gates complete with gate hardware.

3.6 REPAIR

- A. Repair Painting:
 - 1. Wire brush and clean rust spots, welds, and abraded areas immediately after installation, and apply repair paint with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
 - 2. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.7 PROTECTION

- A. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.

END OF SECTION

SECTION 102800 - TOILET, BATH, AND LAUNDRY 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. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Private-use bathroom accessories.
 - 3. Underlavatory guards.
 - 4. Custodial accessories.
- B. Related Sections:
 - 1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. American Specialties, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation.
- B. Grab Bar G1 and G2:
 - 1. Mounting: Flanges with concealed fasteners.
 - 2. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 3. Outside Diameter: 1-1/2 inches.

4. Configuration and Length: As indicated on Drawings.

C. Mirror Unit M1:

1. Frame: Stainless-steel angle, 0.05 inch thick.
 - a. Corners: Welded and ground smooth.
2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
3. Size: As indicated on Drawings.

2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 104413 - FIRE PROTECTION CABINETS

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:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguisher.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Samples for Initial Selection: For each type of exposed finish required.
- E. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Babcock-Davis.
 - b. Fire-End & Croker Corporation.
 - c. Larsens Manufacturing Company.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Surface Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- E. Cabinet Trim Material: Steel sheet.
- F. Door Material: Steel sheet.
- G. Size: 20 lb extinguisher.
- H. Door Style: Fully glazed panel with frame.
- I. Door Glazing: Acrylic sheet.
 - 1. Acrylic Sheet Color: Clear transparent acrylic sheet.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Decals.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.

L. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: As selected by Architect from manufacturer's full range.
2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick.
3. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Miter corners and grind smooth.
 3. Provide factory-drilled mounting holes.
 4. Prepare doors and frames to receive locks.
 5. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:
 - 1. Fire-Protection Cabinets: 54 inches above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
 - 4. Fire-Rated Cabinets:
 - a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
 - b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

- C. Identification:
 - 1. Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 105126 - SOLID PLASTIC LOCKERS (HDPE)

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:
 - 1. Solid plastic lockers.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Division 06: Rough Carpentry.
- C. References:
 - 1. ASTM B221: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Include dimensioned layouts, elevations, trim, closures and accessories.
 - 2. Product Data: Manufacturer's descriptive data.
 - 3. Samples: 3 x 3 inch samples showing available colors in each color.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 years of experience in manufacture of solid plastic lockers with products in satisfactory use under similar service conditions.
- B. Installer Qualifications: Minimum 5 years of experience in work of this Section. Certified installer through manufacturer's installation certification program.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store in an upright condition. Protect plastic lockers from exposure to direct sunlight. This product is not intended for outdoor use.

1.6 WARRANTY

- A. Provide manufacturer's 25 year warranty against breakage, corrosion, and delamination under normal conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Scranton Products (www.scrantonproducts.com) Tufftec Athletic Lockers. Other acceptable manufacturers:
 - 1. ASI Storage Solutions
 - 2. Bradley Corporation
- B. Materials:
 - 1. High Density Polyethylene (HDPE): Polyethylene thermoplastic formed into solid plastic components with homogeneous color throughout, with smooth orange peel finish.
 - 2. Heavy Duty Extruded Aluminum: B221, 6063-T6.
 - 3. Chromium Plated Steel: A167.
 - 4. Color: To be selected from manufacturer's color range.

2.2 STANDARD PLASTIC LOCKERS - TWO TIER

- A. Locker Configuration: Two tier.
- B. Locker Dimensions:
 - 1. Height, Nominal: 72 inch.
 - 2. Width: 12 inch.
 - 3. Depth: 12 inch.
- C. Material: High density polyethylene (HDPE) plastic.
- D. Sides, Tops, Bottoms, Backs, and Shelves: 3/8 inch thick HDPE plastic, grey finish.
 - 1. Sides: 3/8 inch thick HDPE plastic, grey finish, with horizontal side venting.
- E. Locker Tops: Slope top finished in same color as locker door. See Drawings for locations.
- F. Doors and Frame: 1/2 inch thick HDPE plastic.
 - 1. Doors: 1/2 inch thick HDPE plastic with horizontal venting.
 - 2. Handle: ADA compliant ergonomic handle, injection molded plastic.
 - 3. Locks: Provide latch for user provided pad locks.
 - 4. Hinge: Heavy duty extruded aluminum with corrosion free stainless steel pin with black finish.
 - 5. ADA Compliance Package: 3134 aluminum Series 1100, H18, satin matte finish ADA plaque, adjustable 3/8 inch HDPE plastic shelf with plastic clips.
 - 6. Latch Bar: 3/8 inch thick HDPE plastic with multiple latch points, fastened with stainless steel tamper-resistant screws.
- G. Assembly Profile: Full height of lockers, PVC plastic, snap fit assembled onto locker sides.
- H. Accessories:
 - 1. Coat Hook: Two-prong, high impact plastic, black finish, mounted to bottom of shelf or divider, one per door opening.

2. End Panels: ½ inch thick HDPE plastic, color and finish same as locker door.
3. Filler Panels and Trim: ½ inch thick HDPE plastic, color and finish same as locker door.
4. Number Plate: 3134 aluminum, Series 1100, H18, satin matte finish, fastened to locker with corrosion resistant stainless steel rivets.
5. Locker Base: 1 inch thick HDPE plastic, with black finish, 4 inch; field assembly required.
6. Wall Hook: Four per locker.
7. Color: As selected by Architect from manufacturer's color range.

2.3 LOCKER BENCHES

- A. Pedestal-Leg Locker Benches: Bench top supported by pedestal legs, minimum of two pedestals for each bench, with overall height not to exceed 18 inches (457 mm) measured from top of bench to floor, as follows:
 1. Metal Pedestal Legs: 1-1/2-inch- (38-mm-) diameter, stainless steel round tube or pipe.
 2. Bench Tops: 1-1/4 inches (32 mm) deep; fabricated as follows:
 - a. Butcher Block Top: Solid laminated hardwood.
 - b. HDPE plastic or butcher block top, with color as selected by Architect from manufacturer's full range.
 - c. Width: Manufacturer standard not to exceed 12 inches
 - d. Length: 48 inches

2.4 FABRICATION

- A. Fabricate locker components square and rigid; finish free from scratches and chips.
- B. Fabricate locker components for snap-together assembly or slide-together dovetail connections providing solid and secure, anti-racking construction.
- C. Fabricate adjacent lockers with common side panel.
- D. Fabricate locker units for assembly in maximum of three adjacent lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lockers in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Set standard lockers on prepared locker base.
- C. Set plumb, level, rigid, and aligned.
- D. Attach lockers to supporting construction with anchors best suited to substrate conditions.

3.2 ADJUSTING

- A. Adjust doors and latches to operate correctly.

END OF SECTION

SECTION 116623 - GYMNASIUM 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. Section Includes:
 - 1. Pickleball equipment.
 - 2. Volleyball equipment.
 - 3. Safety pads.
 - 4. Scoreboards
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for installation of floor insert sleeves to be cast in concrete slabs and footings.
 - 2. Drawings for game lines and markers.

1.3 DEFINITIONS

- A. FIBA: Federation Internationale de Basketball Amateur (The International Basketball Federation).
- B. FIVB: Federation Internationale de Volleyball (The International Volleyball Federation).
- C. NCAA: The National Collegiate Athletic Association.
- D. NFHS: National Federation of State High School Associations.
- E. USAV: USA Volleyball.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
 - 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: For gymnasium equipment.
 - 1. Include plans, elevations, sections, details, and attachments to other work.

2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, attachments to other work, and operational clearances.
3. Include transport and storage accessories for removable equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Court layout plans, drawn to scale, and coordinated with floor inserts, game lines, and markers applied to finished flooring.
- B. Qualification Data: For Installer.
- C. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.8 COORDINATION

- A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.
- B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension-system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Basketball backboard failures including glass breakage.
 - b. Faulty operation of basketball backstops.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain gymnasium equipment from single source from single manufacturer.

2.2 VOLLEYBALL EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Draper, Inc.
 - 2. Jaypro Sports Construction Group.
 - 3. Performance Sports Systems; a Gared Holdings company.
 - 4. Porter Athletic, Inc.
- B. General: Provide equipment complying with requirements in NFHS's "NFHS Volleyball Rules Book."
- C. Floor Insert: Solid-brass floor plate; and steel pipe sleeve, concealed by floor plate, with capped bottom end, sized with ID to fit post standards, not less than 9 inches long to securely anchor pipe sleeve in structural floor; with anchors designed for securing floor insert to floor substrate indicated; one per post standard.
 - 1. Floor Plate: Lockable swivel access cover, designed for use with floating wood floors and to be flush with adjacent flooring. Provide two tool(s) for unlocking access covers.
- D. Post Standards: Removable, paired volleyball post standards and a center post standard for multicourt play as indicated. Fixed height. Designed for easy removal from permanently placed floor insert supports. Fabricated from manufacturer's standard metal pipe or tubing, with nonmarking plastic or rubber end cap or floor bumper to protect permanent flooring. Finished with manufacturer's standard factory-applied, polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness or plated metal finish.
 - 1. Nominal Pipe or Tubing Diameter: 3-inch OD at base.
 - 2. Net Height Adjuster: Track or rail system and lock mechanism designed for infinite height adjustment, complete with fittings; designed for positioning net at heights indicated.
 - a. Net Heights: Between sitting volleyball net height and boys'/men's volleyball net height, 36 and 95-5/8 inches or more.
 - 3. Telescopic and Net Height Adjuster System: Provide infinitely adjustable system consisting of screw rod, gear, and crank or constant-tension spring and pulley assist and locking device, telescopic post, and fittings for holding net at selected height; designed for height adjustment of post standard to position net at heights indicated.
 - a. Net Heights: Between sitting volleyball net height and boys'/men's volleyball net height, 36 and 95-5/8 inches or more.
 - 4. Height Markers: Clearly marked at regulation play heights for elementary school girls/women boys/men.

- E. Net: 32 feet long; one per pair of paired post standards; and as follows:
 - 1. Width and Mesh: Competition volleyball net, 36 inches with 4-inch-square mesh made of black nylon string.
 - a. Hem Band Edges: White, not less than 2-inch-wide top, bottom, and side bindings; not less than 1-inch-wide tension straps at top, bottom, and midpoint of each side end of net; end sleeves for dowels; and lines with linkage fittings threaded through top and bottom hems of binding. Provide lengths of lines and linkage fittings as required to properly connect to and set up net for post standard spacing indicated on Drawings.
 - 1) Top Line: Not less than 1/8-inch-diameter, galvanized- or coated-steel cable.
 - 2) Bottom Line: Not less than 1/8-inch-diameter, galvanized- or coated-steel cable.
 - 2. Dowels: Not less than 1/2-inch-diameter fiberglass or 1-inch-diameter wood. Provide two dowels per net threaded through each side hem sleeve for straightening net side edges.
 - 3. Net Antennas: 3/8-inch-diameter, high-tensile-strength, extruded-fiberglass or plastic rods, 72 inches long, extending above top hem band of net, with alternating white and red bands according to competition rules. Provide two antennas per net.
 - a. Clamps: Designed to secure antenna to top and bottom of net.
 - 4. Boundary Tape Markers: 2-inch-wide white strip, secured to net top and bottom with hook-and-loop attachment. Provide two tape markers per net for marking court boundaries.
- F. Net-Tensioning System: Designed to adjust and hold tension of net. Fully enclosed, nonslip worm-gear -type winch with cable length and fittings for connecting to net lines, positive-release mechanism, and removable handle. Provide end post with post top pulley. Provide opposing post with welded-steel loops, hooks, pins, or other devices for net attachment and post top grooved line guide.
- G. Bottom Net Lock Tightener: Provide manufacturer's standard quick-release-type tension strap; a spring-loaded, self-locking tensioner; a turnbuckle; a pulley; or other device and linkage fittings designed to quickly and easily tighten bottom line or net.
- H. Judges' Stands: Provide manufacturer's standard units designed to be freestanding, folding for storage with wheels for transporting. Fabricate welded-steel tubing units with finish and color to match post standards.
- I. Safety Pads: Comply with NCAA and NFHS requirements. Provide pads consisting of not less than 1-1/4-inch-thick, multiple-impact-resistant manufacturer's standard foam filler covered by puncture- and tear-resistant fabric cover, not less than 14-oz./sq. yd. PVC-coated polyester, treated with fungicide for mildew resistance; with fire-test-response characteristics indicated. Provide pads with hook-and-loop closure or attachments for the following components:
 - 1. Post Standards: Wraparound style, designed to totally enclose each standard to a height of not less than 66 inches; one per post.
 - 2. Net Lines: Four per net.
 - 3. Judges' Stands: Designed to totally enclose each unit.
 - 4. Fabric Cover Flame-Resistance Ratings: Complies with NFPA 701.
 - 5. Fabric Color: As selected by Architect from full range of industry standard colors and color densities.

- 6. Graphics: Custom graphics as indicated.
- J. Post Standard Transporter: Manufacturer's standard wheeled unit designed for transporting a single post.
- K. Wall Storage Rack: Manufacturer's standard unit designed for mounting on walls and for storing post standards in vertical position with retaining arms, fittings for padlock, and mounting hardware; number of units as required to provide storage for specified equipment. **Located in Room 115-EQUIPMENT STORAGE.**
- L. Storage Cart: Manufacturer's standard wheeled unit designed for transporting and storing volleyball equipment and passing through 36-inch-wide door openings. Fabricate welded-steel tubing units with heavy-duty casters, including no fewer than two swivel casters. Fabricate wheels from materials that do not damage or mark floors; number of units as required to provide transport and storage for specified equipment.

2.3 SLEEVE TYPE PICKLEBALL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Draper, Inc.
 - 2. Jaypro Sports Construction Group.
 - 3. Performance Sports Systems; a Gared Holdings company.
 - 4. Porter Athletic, Inc.
- B. Sleeve Type Pickleball System
 - 1. Basis-of-Design: Subject to compliance with requirements, provide Model 502300 Two Pole, Single Court Pickleball System by Draper, Inc. or similar.
 - 2. Each system consists of one pair of standards, one pickleball net, and center tie down with net strap.
 - 3. Pickleball standards are 2-3/8" OD 3/16" wall high strength steel mechanical tubing furnished with all necessary hardware. Each post has a sliding lock collar to anchor net and provide proper net tensioning. Sliding collar and post shall be finished with durable gloss black powder coat.
 - 4. Pickleball net is constructed of #36 nylon 1-3/4" mesh. Double reinforce white vinyl coated nylon headband with enclosed top cable. Bottom and side include nylon reinforced bindings. Net measures 21' 9" x 36" and is designed for use on a 20' wide court with standard placed at 22' 0" inside-to-inside.
- C. Floor Plate, Brass w/swivel cover
 - 1. Cover Plate shall be DRAPER model 501035 Cover Plate Assembly by Draper, Inc. or similar.
 - 2. Cover plate assembly shall be recessed mounting flange, 5-3/16" in diameter, and a 5" diameter cover. Cover shall be equipped with a swivel type retaining screw to prevent theft. A special key shall be provided for opening cover.

D. Floor Sleeve

1. Floor Sleeves shall be DRAPER Model 501008 2-3/8" I.D. Floor Sleeve by Draper, Inc. or similar.
2. Floor sleeve shall be constructed of steel mechanical tubing with an inside diameter of 2-3/8", welded to a 3" x 3" bottom plate. Sleeve shall be 8-1/2" long and designed to be installed with the bottom at 9 1/2" below the playing surface.

2.4 SAFETY PADS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Draper, Inc.
 2. Jaypro Sports Construction Group.
 3. Performance Sports Systems; a Gared Holdings company.
 4. Porter Athletic, Inc.
- B. Pad Coverings: Provide safety pad fabric covering that is fabricated from puncture- and tear-resistant, PVC-coated polyester or nylon-reinforced PVC fabric, not less than 14-oz./sq. yd and treated with fungicide for mildew resistance; with surface-burning characteristics indicated.
- C. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.
1. Backer Board: Not less than 3/8-inch-thick plywood, mat formed, or composite panel.
 2. Fill: Multiple-impact-resistant foam not less than 2-inch-thick polyurethane, 3.5-lb/cu. ft. density.
 3. Size: Each panel section, 24 inches wide by not less than 72 inches long.
 4. Number of Modular Panel Sections: As indicated.
 5. Installation Method: Concealed mounting Z-clips.
 6. Fabric Covering Color(s): As selected by Architect from manufacturer's full range for one color(s).
- D. Corner Wall Safety Pads: Wall corner pad consisting of not less than 1-1/4-inch-thick, multiple-impact-resistant, closed-cell, polyethylene-foam filler, covered on both sides and all edges by fabric covering with backer board and manufacturer's standard anchorage to wall.
1. Length: Each pad not less than 72 inches.
 2. Fabric Covering Color(s): Match color of wall safety pads for color(s).
- E. Cut-out Trim: Provide manufacturer's standard flanged cut-out trim kits for fitting pads around switches, receptacles, and other obstructions.
1. Color: Gray.

2.5 SCOREBOARDS

- A. Basis-of-Design Product: Model No. BB-1620-4 (consisting of: BB-1600-4 & FP-1601-4) for basketball, volleyball, and wrestling, by Trans-Lux (Fair-Play). Equivalent products may be supplied by one of the following:
 - 1. Daktronics, Inc.
 - 2. All American Scoreboard.
- B. General: Scoreboards, UL Listed/CSA Certified, remotely operated from one control station (included). Display(s) minutes, seconds, team scores, period, bonus, using low voltage 100% Solid State 2-Wire cable multiplex system, quartz crystal controlled.
- C. Dimmer: Lamp intensity dimmer activated from operator's control center keyboard.
- D. Timing: Bi-directional, up or down count. Any number of minutes or seconds can be directly set, capacity 0:00-99:59. Lamps color: red. Timer displays 1/10th seconds during the final minute of the period by shifting the numerals on the time display of the scoreboard to show seconds to the left of the colon and 1/10th seconds to the right of the colon.
- E. Team Scores: Two Scores. Scores may be selectively set to any number, capacity 0-199. Additive mode also provided.
- F. Horn: Located in scoreboard. Sounds automatically at 0:00 for a minimum of two seconds. Operator may select to omit automatic horn. Horn may be sounded manually at any time.
- G. Scoreboard Operator's Control Station: Nevco Model MP-70 Series Wireless, or approved equivalent product by Trans-Lux (Fair-Play). Provide one control station per scoreboard. Provide electrical power connection as per equipment requirements.
 - 1. Included options:
 - a. Model HH-70 Clock Hand Switch for Second Operator (Clock Start/Stop & Manual Horn.)
 - b. Model HC-70 Clock Hand Switch for Second Operator. (Clock Start/Stop & Clock Reset).

2.6 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for use and finish type indicated.
 - 1. Extruded Bars, Profiles, and Tubes: ASTM B 221.
 - 2. Cast Aluminum: ASTM B 179.
 - 3. Flat Sheet: ASTM B 209.
- B. Steel: Comply with the following:
 - 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 2. Steel Tubing: ASTM A 500/A 500M or ASTM A 513, cold formed.
 - 3. Steel Sheet: ASTM A 1011/A 1011M.

- C. Support Cable: 1/4-inch-diameter, 7x19 galvanized-stranded-steel wire rope with a breaking strength of 7000 lb. Provide fittings complying with wire rope manufacturer's written instructions for size, number, and installation method.
- D. Castings and Hangers: Malleable iron, complying with ASTM A 47/A 47M; grade required for structural loading.
- E. Softwood Plywood: DOC PS 1, exterior.
- F. Equipment Wall-Mounted Board: Wood, transparent finish, size, and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.
- G. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed.
- H. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C 1107/C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
 - 1. Verify critical dimensions.
 - 2. Examine supporting structure, subfloors, and footings below finished floor.
 - 3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly where required.
- B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, are completed.
- C. Contractor will be responsible for providing all necessary electrical and data pathways required for scoreboard operation.

- D. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with court layout.
 - 1. Floor Insert Location: Coordinate location with application of game lines and markers, and core drill floor for inserts after game lines are applied.
 - 2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and floor-plate type.
 - 3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.
- E. Floor Insert Setting: Position sleeve in oversized, recessed voids in concrete slabs. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions. Protect portion of sleeve above subfloor from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.
- F. Wall Corner Safety Pads: Mount with bottom edge at 4 inches above finished floor.
- G. Cut-out Trim: Limit cuts in face of padding from trim unit's corner-to-corner outside dimensions. Install with ends of cuts concealed behind trim flange.
- H. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.
- I. Connections: Connect electric operators to building electrical system.
- J. Removable Gymnasium Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble removable gymnasium equipment after assembled configuration is approved by Owner, and store units in location indicated on Drawings.

3.3 ADJUSTING

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING

- A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

- B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION

SECTION 116653 - GYMNASIUM DIVIDERS

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:
 - 1. Roll-up divider systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Motors: Show mounting arrangements and wiring diagram to power source and controls.
- B. Shop Drawings: For gymnasium dividers.
 - 1. Include plans showing alignment of curtains in relation to court layout.
 - 2. Include elevations, sections, details, and attachments to other work.
 - 3. Include system clearances, stacking requirements, and limits for fitting into adjacent construction.
 - 4. Include loads, point reactions, and locations for attachment of gymnasium dividers to structure.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install gymnasium dividers until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify size of space, available clearances, obstructions, and position for gymnasium dividers.

1.7 COORDINATION

- A. Coordinate installation of overhead-supported gymnasium dividers and suspension-system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Electrically Operated Dividers: Coordinate electrical requirements for type and location of power supply, conduit, wiring, and control boxes.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium dividers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of gymnasium dividers.
 - b. Tearing or deterioration of fabric, seams, or other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain gymnasium dividers from single source from single manufacturer.

2.2 ROLL-UP DIVIDER SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Draper, Inc.
 - 2. Jaypro Sports Construction Group.
 - 3. Performance Sports Systems; a Gared Holdings company.
 - 4. Porter Athletic, Inc.
- B. Divider Curtain System: Electrically operated with roll-up drive pipe, and as follows:
 - 1. Top Hem: Double-thickness mesh or solid vinyl for continuous pipe batten.
 - 2. Outer Edge Hems: Double turned and welded.
 - 3. Belts: 4-inch-wide polyester or polyurethane webbing or fabric belts, attached to top batten, passing under bottom batten, and terminating at drive pipe, with friction surface on one side of belt or other means of drawing up curtain by rolling at bottom batten.
 - 4. Support Chain and Fittings: Hardened alloy steel chain rated for lifting loads indicated, with commercial-quality, corrosion-resistant steel connectors and hangers.
 - 5. Curtain Battens and Drive Pipe: Fabricate from steel pipe or tubing with a minimum number of joints, as necessary for required lengths. Provide galvanized battens, or shop prime and shop finish with black paint.
 - a. Drive Pipe: 2-3/8-inch-nominal diameter steel pipe.
 - b. Top Batten: 1-1/2-inch-nominal diameter steel pipe.
 - c. Bottom Batten: 3-1/2-inch-nominal diameter steel pipe.

2.3 MATERIALS

- A. General-Purpose Chain: For chains not used for overhead lifting, provide carbon steel chain, complying with ASTM A 413/A 413M, Grade 30 proof coil chain or other grade recommended by gymnasium divider manufacturer. Provide coating type, chain size, number, and installation method complying with manufacturer's written instructions.
- B. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed.

2.4 ELECTRIC OPERATORS

- A. General: Factory-assembled electric operation system of size and capacity recommended and provided by gymnasium divider manufacturer for gymnasium dividers specified, with electric motors, thermal-overload protection, factory-prewired motor controls, control devices, and accessories required for proper operation. Include wiring from control stations to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop dividers at fully extended and fully retracted positions.
- D. Control System:
 - 1. Key Operation: NEMA ICS 6, Type 1 enclosure, momentary-contact, three-position switch-operated control.
 - a. Keys: Provide two key(s) per station.

2.5 DIVIDER CURTAINS

- A. Upper Curtain, Mesh: Woven mesh of polyester yarn coated with vinyl, weighing not less than 7 oz./sq. yd.
 - 1. Mesh Color: As selected by Architect from full range of industry colors and color densities.
- B. Lower Curtain, Solid: Woven polyester fabric coated with vinyl, 22 oz./sq. yd., 12'-0" height above floor.
 - 1. Fabric Color(s): color(s), as selected by Architect from full range of industry colors and color densities.
- C. Hems: Folded and electronically welded.
- D. Seams: Electronically welded.
- E. Overall Curtain Height: Floor to ceiling, within installation clearances required.
- F. Bottom of Curtain: Approximately 2 inches above finished floor.
- G. Divider Curtain Flame-Resistance Ratings: Passes NFPA 701, Test 2.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for alignment of mounting substrates, installation tolerances, operational clearances, building electrical system connection types and locations, and other conditions affecting performance of the Work.
 - 1. Verify critical dimensions.
 - 2. Examine supporting structure.
 - 3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions.
- B. Unless otherwise indicated, install gymnasium dividers after other finishing operations, including painting, are completed.
- C. Gymnasium Dividers and Components: Install level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with court layout.
 - 1. Verify clearances for movable components of gymnasium dividers throughout entire range of operation and for access to operating components.
- D. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure gymnasium dividers to structural support and to properly transfer load to in-place construction.
- E. Connections: Connect automatic operators to building electrical system.

3.3 ADJUSTING

- A. Adjust movable components of gymnasium dividers to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, uneven tension, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.
- B. Limit Switch Adjustment: Set and adjust upper and lower limit controls.

3.4 CLEANING

- A. After completing gymnasium divider installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

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- B. Replace gymnasium divider components and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain gymnasium dividers.

END OF SECTION

SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

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:
 - 1. Plastic-laminate-clad casework.
 - 2. Casework hardware and accessories.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood blocking for anchoring casework.
 - 2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring casework.
 - 3. Section 096513 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-clad casework.
 - 4. Section 123661 "Solid Surface Countertops."

1.3 DEFINITIONS

- A. Definitions in the AWI/AWMAC/WT's "Architectural Woodwork Standards" apply to the Work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

1.5 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plastic-laminate-clad casework.
 - 1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
 - 2. Indicate types and sizes of casework.
 - 3. Indicate manufacturer's catalog numbers for casework.
 - 4. Show fabrication details, including types and locations of hardware.
 - 5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and equipment.
- C. Keying Schedule: Include schematic keying diagram, and index each key set to unique designations that are coordinated with the Contract Documents.
- D. Samples: For casework and hardware finishes.
- E. Samples for Initial Selection: For casework and hardware finishes.
- F. Samples for Verification: For the following:
 - 1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.
 - a. Provide one Sample applied to core material with specified edge material applied to one edge.
 - 2. Thermoset Decorative Panels: 8 by 10 inches, for each color, pattern, and surface finish.
 - a. Provide edge banding on one edge.
 - 3. Base Cabinet: One full-size, 16-inch-wide, finished base cabinet complete with hardware, doors, and drawers but without countertop.
 - 4. Wall Cabinet: One full-size, 12-inch-wide, finished wall cabinet complete with hardware, doors, and adjustable shelves.
 - 5. Full-Size Samples: Maintain at Project site during construction in an undisturbed condition as a standard for judging the completed Work. Unless otherwise indicated, approved sample units may become part of the completed Work if in undisturbed condition at time of Substantial Completion. Notify Architect of their locations.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program.
- C. Sample Warranty: For special warranty.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer AWI's Quality Certification Program accredited participant.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework 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 during remainder of construction period. Maintain temperature and relative humidity during remainder of construction period in range recommended for Project location by the AWI/AWMAC/WT's "Architectural Woodwork Standards."
- B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.
- D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. CampbellRhea.
 - 2. Case Systems.
 - 3. Mid Canada Millwork Ltd.
 - 4. R. C. Smith Company.
 - 5. Terrill Manufacturing Company.
 - 6. TMI Systems Design Corporation.
- B. Source Limitations: Obtain from single source from single manufacturer.

2.2 GENERAL REQUIREMENTS FOR CASEWORK

- A. Quality Standard: Unless otherwise indicated, comply with the AWI/AWMAC/WT's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
 - 1. Grade: Premium.
 - 2. Provide inspections of casework fabrication and installation together with labels and certificates from AWI certification program indicating that casework complies with requirements of grades specified.
- B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-clad casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 016600 "Product Requirements."
- C. Product Designations: Drawings indicate configurations of manufactured plastic-laminate-clad casework by referencing designations of Casework Design Series numbering system in the Appendix of the AWI/AWMAC/WT's "Architectural Woodwork Standards."

2.3 PLASTIC-LAMINATE-CLAD CASEWORK

- A. Design: Frameless cabinet construction with the following door and drawer-front style:
 - 1. Flush overlay.
- B. Grain Direction for Wood-Grain Plastic Laminate:
 - 1. Doors: Vertical with continuous vertical matching.
 - 2. Drawer Fronts: Horizontal.
 - 3. Face Frame Members: Lengthwise.
 - 4. End Panels: Vertical.
 - 5. Bottoms and Tops of Units: Side to side.

6. Knee Space Panels: Vertical.
 7. Aprons: Horizontal.
- C. Exposed Materials:
1. Plastic-Laminate Grade: HGS HGL VGS.
 - a. Colors and Patterns: As selected by Architect from manufacturer's full range.
 2. Edgebanding: PVC.
 - a. PVC Edgebanding Color: As selected by Architect from casework manufacturer's full range.
- D. Semiexposed Materials:
1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
 - a. Colors and Patterns: As selected by Architect from manufacturer's full range.
 - b. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
 2. Hardboard: Use only for cabinet backs where exterior side of back is not exposed.
 3. Unless otherwise indicated, provide specified edgebanding on all semiexposed edges.
- E. Concealed Materials:
1. Solid Wood: With no defects affecting strength or utility.
 2. Plywood: Hardwood plywood.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602, self-closing. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.
1. Degrees of Opening: 100 degrees.
- C. Wire Pulls: Solid stainless steel or chrome-plated brass wire pulls, fastened from back with two screws.
1. Provide two pulls for drawers more than 24 inches wide.
- D. Door Catches: dual, self-aligning, permanent magnet catch. Provide two catches on doors more than 48 inches high.
- E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
 2. Drawers: Provide one bumper on back side of drawer front at each corner.

- F. Drawer Slides: BHMA A156.9, Type B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-overtravel-extension type; zinc-plated, steel ball-bearing slides.
- G. Drawer and Hinged-Door Locks: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.
 - 1. Provide a minimum of two keys per lock and six master keys.
 - 2. Provide locks where indicated.
 - a. Masterkey for up to 250 key changes.
- H. Adjustable Shelf Supports: Single-pin metal shelf rests complying with BHMA A156.9, Type B04013.

2.5 MATERIALS

- A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.
- C. Softwood Plywood: DOC PS 1.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
- F. Hardboard: ANSI A135.4, Class 1 tempered.
- G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Formica Corporation.
 - b. Nevamar; a Panolam Industries International, Inc. brand.
 - c. Wilsonart LLC.
 - 2. Source Limitations: Obtain from single source from single manufacturer.
- H. PVC Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 0.12 inch thick at doors and drawer fronts, 0.04 inch thick elsewhere.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PLASTIC-LAMINATE-CLAD CASEWORK

- A. Grade: Install casework to comply with same quality standard grade as item to be installed.
- B. Install casework level, plumb, and true in line; shim as required using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten cabinets to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
- E. Fasten casework to adjacent units and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI/AWMAC/WT's "Architectural Woodwork Standards."
- F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- G. Adjust operating hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 CLEANING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION

SECTION 123661 - SOLID SURFACE COUNTERTOPS

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:
 - 1. Solid-surface-material countertops and backsplashes.
 - 2. Solid-surface-material window stool.
- B. Related Sections:
 - 1. Section 123216 "Manufactured Plastic-Laminate-Clad Casework."

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.
 - 2. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS (SS-1)

- A. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Front: Radius edge with apron, 1 1/2 inches high with 3/8-inch radius.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. Endsplash: Matching backsplash.
- B. Countertops: 3/4-inch-thick, solid surface material with front edge built up with same material.
- C. Window Stool: 3/4-inch-thick, solid surface material.
- D. Backsplashes: 1/2-inch-thick, solid surface material.
- E. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.

2.2 COUNTERTOP MATERIALS

- A. Adhesives: Adhesives shall not contain urea formaldehyde.
- B. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. E. I. du Pont de Nemours and Company.
 - b. Formica Corporation.
 - c. Wilsonart.
 - 2. Type: Provide Standard Type unless Special Purpose Type is indicated.
 - 3. Colors and Patterns: As indicated and/or selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet.

- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

END OF SECTION

SECTION 210500 - FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 21 Fire Sprinkler Systems.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws, and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
 - 2. Able to furnish evidence of having contracted for and installed not less than three (3) systems of comparable size and type that has served their Owners satisfactorily for not less than three (3) years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimums for all equipment, material, and work. In instances where specified capacities, size, or other

features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain three (3) sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducibles is a condition of final acceptance.
 - C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, etc. that were deviated from construction drawings.
 - 6. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 7. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 8. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
 - 9. Exact location of all electrical equipment in and outside of the building.
 - 10. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for one (1) year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 21 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit three (3) copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit three (3) copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.

- C. Concrete pads:
 - 1. Four-inch high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner two (2) suitable tools for use with each type of fastener used.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 4 hours dedicated instructor time.
 - 2. 2 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with ½-inch high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

SECTION 211000 - FIRE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Design coordination of sprinkler work with the installations of other trades as shown on their drawings; all mechanical, electrical, plumbing and sprinkler work must fit the space requirements. The sprinkler work shall comply with other Sections of this specification; and fit the structure finishes. The Sprinkler Contractor will comply with all the codes and underwriter authorities, and the requirements for the installation of inside and outside piping; including sprinkler heads, valves, tamper switches, flow switches, hangers and supports, sleeves, fire department connections, inspector test connections, main drain and accessories, signs and any other component parts reasonably incidental to providing a complete protection system. Provide 100 percent coverage for the entire building.
- B. A wet system shall be installed in heated areas.
- C. Furnish all articles of a completed sprinkler system including all materials, labor, tools, equipment, transportation services and supervision fees.
- D. The plans provide a riser assembly location at water entry into building for flow switch locations, valve locations (with tamper switches), fire department test assemblies and fire department Siamese connections. These are a guide for subsequent preparation of the Contractor's detailed installation drawings of the complete fire protection sprinkler system which shall be submitted to the Architect / Engineer for review.
- E. The installation of the entire Sprinkler Systems shall comply with all rules and regulations of the National Board of Fire Underwriters, the Local Building Code, Local Fire Marshall, and Requirements of NFPA Pamphlet 13, and other local authorities exercising jurisdiction.
- F. Study the general, structural, electrical and mechanical drawings and specifications, in order to become familiar with the building and details as they apply to the work of this Section. Cooperate with all Trades so that there will be no conflict of space. Plumbing flow lines, large ductwork HVAC piping and electrical service feeders shall take precedence over Fire Protection work, except where it is absolutely necessary to maintain coverage protection.

1.2 BASIS OF DESIGN

- A. National Fire Protection Association (NFPA), latest edition of NFPA 13, Standard for the Installation of Sprinkler Systems.
- B. Vertical zone valves installed in horizontal position are not acceptable. All zone valves are to be located at water entry into building and mounted in the vertical riser.

1.3 QUALITY ASSURANCE

- A. Sprinkler equipment and installation to be in accordance with recommendations of and approved by local, state and federal fire authorities.
- B. Equipment and installation to meet requirements of NFPA No. 13, 24, 25, 70 and 72.
- C. Use materials and equipment that are new and of unused, approved by NFPA and as listed in the UL list of "Inspected Fire Protection Equipment and Materials."

1.4 SHOP DRAWINGS

- A. Make complete shop drawings and working drawings of equipment furnished, including detailed drawings of piping and sprinkler head locations.
- B. The Architect's approval of shop drawings shall not relieve the responsibility of correctly figured dimensions or any errors that may be contained in these drawings. The omission of any material shown on the contract drawings, or specified from the shop drawings, even though approved, shall not relieve the responsibility to furnish and erect them.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Tyco Fire Products
 - 1. Anvil
 - 2. Gem
 - 3. Central
- B. Automatic Sprinkler Company of America
- C. Potter Roemer, Inc.
- D. The Reliable Automatic Sprinkler Company
- E. Viking Corporation
- F. Victaulic Company of America

2.2 PIPING AND FITTINGS

- A. Above Slab Inside Building. Schedule 40, black steel pipe conforming to ASTM A 795 or ASTM A135 joined with threaded fittings.
- B. Underground within five feet of building. Provide ductile iron pipe, Class 200 conforming to ASTM, and ring-tite fittings. Provide concrete thrust blocks at changes in direction, according to the pipe manufacturer's recommendations.
- C. Fittings used to join pipe shall be listed fabricated fittings or manufactured in accordance to the material and dimension standards listed in table 6.4.1 NFPA 13 and 2.2.1 NFPA 14.

2.3 SPRINKLER HEAD

- A. All sprinklers shall comply with the latest requirements of NFPA 13 with respect to orifice size.
- B. All heads shall be UL listed and FM approved, and comply with the latest requirements of NFPA 13 with respect to orifice size unless otherwise noted. Sprinkler heads with “O” ring design shall not be acceptable.
- C. Exposed areas: Standard upright type, with 155 degree F temperature. Tyco Model TY-B, TY-FRB, or equal. Sprinkler head color to be chrome.
- D. Suspended ceilings: Standard Recessed Pendant type with escutcheon, with 155 degree F temperature. Tyco Model TY-B, TY-FRB, or equal. Sprinkler head and escutcheon color to be chrome.
- E. Suspended ceilings: Adjustable concealed type heads with manufacturer painted cover plate with glass bulb fusible link, with 155 degree F temperature rating. Tyco Model RFII or equal. Cover plate color to be white.
- F. Sprinklers subject to mechanical injury shall be protected with fusible solder type sprinklers and listed guards. Bulb type sprinklers will not be acceptable for these locations.
 - 1. Storage rooms with exposed structure.
 - 2. Mechanical and Electrical rooms.
 - 3. Below exposed stairs.

2.4 INSPECTOR’S TEST CONNECTION

- A. Provide UL Listed inspector’s test connection as required by NFPA 13. Ductile iron module housing with combination sight glass, orifice and bonnet assembly

2.5 TAMPER SWITCH / SUPERVISORY SWITCH

- A. Provide Tamper switch on each valve that controls or shuts off the sprinkler system or any portion thereof. The Tamper switch shall be either one single pole, double throw switch or two single pole, double throw switches as required. Switch shall be compatible with installed valve for standard mounting.

2.6 FLOW SWITCH

- A. Provide Vane type flow switch.
 - 1. Self-contained pneumatic, adjustable retard.
 - 2. Two, single pole, double throw switches.
 - 3. Red enamel tamper proof switch housing with flow paddle.
 - 4. Potter Roemer Model No. 6200, or approved equal

2.7 FLOORS AND CEILING PLATES

- A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.8 VALVES

- A. Use valves suitable for 175 psig WOG.
- B. Valves to be UL listed and FM approved.
- C. Valve Connections:
 - 1. Provide valves suitable to connect adjoining piping as specified for pipe joints. Use full line size valves unless noted otherwise.
 - 2. Screwed ends for pipe sizes 2 inches and smaller.
 - 3. Flanged ends for pipe sizes 2-1/2 inches and larger.
 - 4. Solder or screw to solder adapters for copper tubing.
 - 5. Use grooved body valves with mechanical grooved jointed piping.
- D. Gate Valves:
 - 1. Up to 2 inches, bronze, outside screw and yoke, rising stem, solid wedge, screwed ends, manufactured by: Mueller, or approved equal.
 - 2. Over 2 inches, iron body, bronze trim, outside screw and yoke, rising stem, solid wedge, flanged ends; manufactured by Mueller, or approved equal.
- E. Check Valves:
 - 1. Up to 2 inch, bronze, regrind bronze swing disk, solder or screwed ends; 200 WOG, manufactured by Mueller, or approved equal.
 - 2. Over 2 inch, iron body bronze trim, swing disk, regrind – renew bronze disk and seat, flanged ends; 200 WOG, manufactured by Mueller, or approved equal.
- F. Butterfly Valve: Lug body style, bubble-tight shutoff, cast iron body, ASTM B 148 bronze disk, with integral tamper switch, manufactured by Anvil Model No. 8000 FP, or approved equal.
- G. Freestanding Indicating Post: Install adjustable indicating post and valve outside building where shown on Civil drawings, consisting of UL/FM, non-rising stem gate valve and indicating post. Gate valve shall be iron body, non-rising stem, bronze mounted. Indicator flange, 175-psi non-shock rating, flanged end. Indicator shall be UL/FM approved cast iron body, Plexiglas window and 18-inch adjustment span with handle and tamper switch wired to main fire alarm control panel.

2.9 ELECTRIC ALARM BELL

- A. 10-inch round red enamel steel bell with electrically operated vibrating outdoor alarm bell, UL listed, red enamel steel, manufactured by Simplex, or approved equal. Provide power as required for bell.

2.10 GAUGES

- A. Gauges shall be bourdon tube type with minimum 4-1/2 inch dial and die cast aluminum case with screwed ring and black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube, brazed at socket and tip. The accuracy of the gauge shall be within one-half of one percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure and compound gauges shall have suitable scale ranges and graduations. Suitable for temperatures up to 120 degrees F.
- B. Gauges shall have 1/4 inch connections and be mounted with combination stop / snubber needle valve with suitable pressure rating. Scale ranges: 0-200 psi.
- C. Gauge range shall be such that system normal operating pressure falls with 25 percent and 75 percent of the full-scale range.
- D. Pressure scale graduations shall read in psig. Figure intervals shall be in – 20 psig increments, with minor divisions in 2 psig increments.
- E. The accuracy of the gauge shall be at least 0.5 percent of the scale range. Gauge shall be made in accordance with ASME B40.1 accuracy grade 2A.

2.11 SPARE SPRINKLER HEAD BOX

- A. Provide baked enamel steel box to store each type of sprinkler head based on the below numbers for emergency replacement. Numbers below are for each type of head. Provide sprinkler wrench.
 - a. Less than 300 heads: 6 spare heads
 - b. 300 to 1,000 heads: 12 spare heads
 - c. More than 1,000 heads: 24 spare heads.

2.12 ALARM CHECK VALVE

- A. Provide Variable UL listed check valve for City Supplied systems pressure trim set.

2.13 WATER MOTOR ALARM

- A. Provide a red enamel motor alarm for installation on exterior wall.
 - 1. Tyco Model WMA-1 or approved equal.

2.14 SIAMESE FIRE DEPARTMENT CONNECTION

- A. Provide a 4" X 2-1/2" x 2-1/2" Siamese Wall mounted polished brass plated Siamese. Include caps, sillcock, chain, and a plate lettered AUTO-SPKR.

PART 3 - EXECUTION

1.1 DESIGN

- A. Design, spacing of sprinkler heads and selection sizes shall conform to the requirements of NFPA 13 for the indicated occupancy.

- B. Design and install the system so that no part will interfere with doors, windows, heating, mechanical, lighting or electrical equipment. Do not locate sprinkler heads closer than 3 feet to lighting fixtures or other obstructions.
- C. Uniform discharge density design shall be based on hydraulic calculations using the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform to NFPA 13.
- D. Friction losses in pipe will be based on a value of “C” = 120 in the Hazen and Williams formula.

1.2 LOCATION

- A. Heads shown, if indicated on reflected ceiling plans, are an integral part of the ceiling design. Where heads are not shown or indicated, locate them in the exact center of acoustical ceiling tile unless noted otherwise. In rooms with monolithic plaster or gypsum drywall ceilings, locate the sprinkler heads symmetrically arranged with respect to both axes of the room. Locate sprinkler heads in relation to specialty ceiling elements such as slats, ribs, panels, grids, etc., if not shown on the drawings. Generally, locate heads in the exact center of, or spaced between, such elements. Center heads in corridors.
- B. Locate heads as may be required for coordinated ceiling pattern, even though number of heads exceed minimum code requirements.
- C. Sprinkler heads located in utility or mechanical rooms, penthouses, service corridors, or other such spaces not subject to public view need not be centered in ceiling patterns and may use a straight drop from branch line.

1.3 INSTALLATION

- A. Run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only heads.
- B. Protect sprinkler heads against mechanical injury with standard guards.
- C. Locate system drains and inspector’s test connections in utility rooms, mechanical rooms or other readily accessible areas not requiring access through ceiling. Coordinate sprinkler system drain flow rates with plumbing system drainage capacities.
- D. Locate outside alarms on wall of building and coordinate with Architect.
- E. Provide on interior wall near sprinkler valve, cabinet containing extra sprinkler heads of each type and wrench suitable for each head type.
- F. Install pipe markers to identify fire protection.
- G. Provide shield or deflector for sprinklers or equipment where electrical switchgear, switchboards and motor control centers are in sprinkler protected spaces.

- H. Install fire 2-1/2 inch department valve, maximum 5 feet above floor, complying with NFPA 14.
- I. Furnish and install, next to the sprinkler riser main, a print sheet protected by glass or a transparent plastic cover, giving brief instructions regarding control, emergency procedure, and other data required by NFPA #13. For hydraulically designed sprinkler systems, a placard is to be permanently attached to the riser indicating the location, and the basis of design (discharge density and system demand).
- J. Do not install exposed piping below structure in public area.

1.4 COORDINATION

- A. Coordinate the installation schedule for this work with the construction schedule for the Work to ensure orderly progress with minimum delay.
- B. Coordinate interface of fire sprinkler system with the work of other trades to ensure proper and adequate provision for the installation and connection of this system.
- C. Coordinate location and quantity of Siamese connections required for fire department connection with Architect and local fire officials.

1.5 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.
- B. Provide supports both sides of elbows for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed.
- D. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Steel Max. Support Spacing, Feet	Minimum Rod Diameter, Inches
1" & smaller	6	1/4
1-1/4" & 1-1/2"	8	1/4
2"-5"	10	3/8
6" and above	10	1/2

1.6 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- C. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- D. Caulk sleeves water and airtight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.
- E. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view.

1.7 CLEANING OF PIPING SYSTEMS

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.

1.8 FLUSHING AND TESTING

- A. Testing and flushing of installation of sprinkler system shall be in accordance with NFPA 13, and NFPA 25.
- B. Flush sprinkler piping in accordance with NFPA 13. Additionally, flush all alarm valves, and all main piping up to valve.
- C. In addition to NFPA 13 required tests, provide flow switch test and tamper switch test for each device, and verify alarm valve operation.

1.9 PIPE MARKERS

- D. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

- E. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- F. Install identification in the following locations:
 - 1. Both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- G. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

1.10 TESTING AND ACCEPTANCE

- A. Prior to connecting to the overhead sprinkler piping, flush the underground main. Secure required approvals of the flushing operations.
- B. Upon completion of the fire sprinkler system installation, test and retest the complete installation and make corrections as necessary to obtain acceptance by the Fire Marshall and/or any other authority having jurisdiction. Furnish test equipment and personnel required.

1.11 TRAINING

- A. At a time mutually agreed upon, provide instruction to the Owner's designated personnel on the operation and maintenance of the automatic sprinkler system and associated equipment. Owner's Operation and Maintenance Manual prepared for this project shall be used during the instruction.

END OF SECTION

SECTION 220500 - PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 22 Plumbing.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than three (3) systems of comparable size and type that has served their Owners satisfactorily for not less than three (3) years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimums for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 3. Indicate exact location of all underground plumbing and flow line elevation.
 - 4. Indicate exact location of all underground plumbing piping and elevation.
 - 5. Indicate exact location of all underground electrical raceways and elevations.
 - 6. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 7. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 8. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
 - 9. Exact location of all electrical equipment in and outside of the building.
 - 10. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for one (1) year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturer's names and catalog number specified under sections of Division 22 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit three (3) copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit three (3) copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

1.17 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.18 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.
- C. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.19 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.20 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

1.21 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

1.22 ELECTRICAL PROVISIONS OF PLUMBING WORK

- A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.
- B. Types of work normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for mechanical equipment.
 - 2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
 - 5. Wiring of all related circulating water system chemical treatment devices.
 - a. Low voltage electric contacting water meter
 - b. Solenoid valve/blow-down assembly
- C. Refer to Division 23 Controls Sections for related control system wiring.

- D. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment, junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.
- E. Verify voltage on electrical plans.

1.23 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances
- B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- C. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, or NOT APPLICABLE. Explain all DO NOT COMPLY statements.
- D. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.24 CONTRACTOR SUBMITTAL AND SHOP DRAWING RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Manufacturer's catalog numbers.
 - 4. Conformance with requirements of Contract Documents.
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless

Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.

- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities.
 - 2. That the item will fit in the available space in a manner that will allow proper service.
 - 3. Construction methods, materials and finishes.
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. Four-inch high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings.
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab.
- D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner two (2) suitable tools for use with each type of fastener used.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 4 hours dedicated instructor time.
 - 2. 2 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.

2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
3. Submit schedule of equipment to be included and designations.

B. Provide nameplates with ½-inch high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.8 OPERATION AND MAINTENANCE MANUAL

- A. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer.
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement.
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.

- 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Copy of each warranty, bond, and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in the event of failure.
 - 2) Instances that might affect validity of warranties or bonds.
 5. Shop drawings and product data, as specified.
- B. Sections for Equipment and Systems:
1. Content for each unit of equipment and system as appropriate.
 - a. Description of unit and component parts.
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions.
 - c. Maintenance procedures:
 - 1) Routine operations.
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer.
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Schedule of filters for each air handling system.

- k. Schedule of belts for each item of equipment.
 - l. Each Contractor's coordination drawings.
 - m. As installed color coded piping diagrams.
 - n. Charts of valve tag number, with location and function of each valve.
 - o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - p. Other data as required under pertinent sections of the specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
 - 4. Provide complete information for products specified in Division 23.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.

END OF SECTION

SECTION 211000 – PLUMBING PIPING AND FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install plumbing piping in buildings and site. Insulate all domestic water piping above grade. All domestic water products including, but not limited to, pipe, fittings, and fixtures shall be 'Lead Free'
- B. Cellular core PVC pipe is not permitted.
- C. Furnish and install sinks, fixture carriers and plumbing appurtenances.

1.2 JOB REQUIREMENTS

- A. Furnish plumbing fixtures and trim as shown and specified. Provide faucets, fittings, supply stops and similar devices of a single manufacturer. Furnish faucets and supply stops with renewable seats. Porcelain to steel and enameled cast iron fixtures shall be acid resistant. Wall hung fixtures shall be installed with a fixture carrier.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING AND FITTINGS

- A. Above Slab Piping. Provide seamless ASTM B 88 and ANSI/NSF Standard 61 drawn tempered (hard) Type L copper water tube with wrought copper or bronze fittings with solder-joints, ANSI B16.22. Solder material shall be 95-5 (lead free) (Tin-Antimony-Grade 95TA) ASTM B 32.
- B. Air Chambers. Provide a minimum 18-inch long air chamber, of the same size and connecting pipe material at each single lavatory, sink, drinking fountain or fixture that does not have a quick-closing valve or electrical, pneumatic, spring loaded type, or flush valve. Air chambers to be used for remote fixtures and not mixed with water hammer arrestors at group toilets.
- C. Water Hammer Arrestors. Provide piston type hydraulic engineered/manufactured water hammer arrestors in cold and hot water supply lines in chases or walls to each fixture branch or battery of fixtures serving quick closing valves of electrical, pneumatic, spring loaded type, or quick hand closure valves on fixture trim. Provide water hammer arrestors at the end of the branch line between the last two fixtures served. Provide Precision Plumbing Products, Inc., or equal. Size units according to water hammer arrestor's Standard PDI WH-201; refer to schedule on drawings.
- D. Insulation. 3/4" Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips.

- E. PEX system must be listed ASTM F876/F877. Tubing shall be listed PEX 5006 for chlorine resistance for continuous usage up to 140°F. All tubing installed in return air plenums shall be listed ASTM E84. The listing may be for the tubing itself or for the tubing including insulation to achieve the listing. The fittings shall be of the same manufacturer as the tubing and the installation instructions of the manufacturer shall be strictly adhered to. Viega PureFlow or Uponor Systems only.

2.2 SANITARY SEWER PIPE AND FITTINGS

- A. Above Slab Piping: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82 and NSF 14.
- B. Above Slab Pipe in Return Air Plenum and Open Ceiling Area:
 - 1. Service weight cast iron hub and spigot pipe and fittings.
 - 2. Compression type, with neoprene gaskets shall conform to ASTM C-564.
 - 3. Pipe shall conform to requirements of ASTM A74.
- C. Below Slab on Grade Piping: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82 and NSF 14.

2.3 SANITARY VENT PIPE AND FITTINGS

- A. Above Slab Piping in Walls: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82 and NSF 14.
- B. Below Slab on Grade Piping: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82 and NSF 14.

2.4 STORM DRAIN PIPE AND FITTINGS

- A. Above Slab Piping in Walls: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent-welded joints. Pipe and fittings shall conform to ASTM D1785 (PVC Schedule 40) and ASTM D2665 (PVC DWV).
- B. Below Slab on Grade Piping: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent-welded joints. Pipe and fittings shall conform to ASTM D1785 and ASTM D2665.
- C. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing. Install insulation of clean, dry piping.
- D. Insulation shall be wrapped tightly on the piping with all circumferential joints and longitudinal joints overlapped a minimum of 2" with facing to the outside to obtain specified R-value using a maximum of 25% compression.
- E. Provide vapor retarder at penetrations, joints, seams and damage to the facing with staples and FSK foil tape. The facing shall be taped with a minimum 3" wide strip of reinforced foil

tape. Pressure-sensitive tape shall be a minimum 3” (76mm) wide and shall be applied with moving pressure using an appropriate sealing tool. Staples shall be outward cinch and placed 6” (152mm) on center.

- F. Mechanical / Electrical rooms and above ceilings are considered concealed spaces.

2.5 ACCEPTABLE FIXTURE MANUFACTURERS

- A. Vitreous China:
1. American Standard.
 2. Kohler.
 3. Toto
 4. Zurn
- B. Plumbing Faucets:
1. Bradley.
 2. American Standard.
 3. Chicago.
 4. T&S Brass.
 5. Zurn.
 6. Symmons.
 7. Speakman
 8. Moen Commercial
 9. Delta Commercial
- C. Supports and Carriers:
1. Zurn.
 2. J.R. Smith.
 3. Wade.
 4. Josam.
 5. Watts
 6. MIFAB
- D. Flush Valves:
1. Sloan
 2. Zurn
 3. Moen Commercial
- E. Supplies, Stops and Chrome Plated Tubular Brass:
1. McGuire
 2. Kohler
 3. Chicago
 4. Zurn
- F. Water Closet Seats:
1. Beneke
 2. Church
 3. Olsonite
 4. Bemis

- 5. Centoco
- G. Electric Drinking Fountains:
 - 1. Halsey Taylor
 - 2. Elkay
 - 3. Oasis
 - 4. Haws
 - 5. Acorn Aqua
- H. Floor Drains:
 - 1. Zurn
 - 2. J.R. Smith
 - 3. Josam
 - 4. Wade
 - 5. Watts
 - 6. Sioux Chief
 - 7. MIFAB
- I. Cleanouts:
 - 1. Zurn
 - 2. J.R. Smith
 - 3. Josam
 - 4. Wade
 - 5. Watts
 - 6. MIFAB
- J. Stainless Steel Sinks:
 - 1. Elkay
 - 2. Just
 - 3. Griffin
 - 4. Moen Commercial
 - 5. Amtekco INdustries
- K. Mop Sinks:
 - 1. Crane Fiat
 - 2. Stern Williams
 - 3. Acorn
 - 4. CECO
- L. Thermostatic Mixing Valves
 - 1. Lawler
 - 2. Symmons
 - 3. Leonard
 - 4. Powers
 - 5. Holby
 - 6. Bradley
 - 7. Acorn
- M. Shock Arrestors:
 - 1. Precision Products

- 2. Sioux Chief
 - 3. MIFAB
- N. Backflow Preventors
 - 1. Watts
 - 2. Febco
 - 3. Wilkins
- O. Hose Bibbs
 - 1. Chicago
 - 2. Josam
 - 3. Woodford
 - 4. Zurn
 - 5. J.R. Smith
 - 6. Wade
 - 7. MIFAB
- P. Wall Hydrants
 - 1. Woodford
 - 2. MIFAB
 - 3. Zurn
 - 4. J.R. Smith
 - 5. Josam
 - 6. Wade

PART 3 – EXECUTION

3.1 SANITARY INSTALLATION

- A. Give horizontal pipe grade of ¼-inch per foot where possible, but not less than 1/8 inch per foot unless otherwise shown.
- A. Above ground installation in the horizontal position shall be supported at every hub. Hangers to be placed within 18” of hub or coupling. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15’-0”.
- B. All above and below slab PVC sanitary waste and vent piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer’s recommendations and applicable standards.
- C. All PVC underground shall be installed in accordance with ASTM D2321.
- D. Offsets and Fittings.
 - 1. Use reduction fittings to connect two pipes of different diameter.
 - 2. Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and sixth-, eights-, and sixteenth-bends. Sanitary tees can be used on vertical stacks. Use long sweeps at the base of risers.

3. Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a deep seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.
- E. Cleanouts. Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4 inches in diameter.
 1. Where cleanouts occur in pipe chases, bring the cleanouts through the walls and install covers. Where cleanouts occur in floor slabs, set flush. Reference drawing schedule.
 2. Provide cleanouts where soil lines change direction, every 50 foot on long runs, or as shown on the drawings, at the end of each horizontal waste line, and at the base of each riser (and at each increase in pipe size).
 3. Cleanouts shall occur at the end of each battery of water closets, urinals, lavatories, sinks, and single water closets. Cleanouts shall be installed so as to access the main sanitary or soil line. Extend and offset above flood rim of fixture.
 4. Double sanitary tees and double quarter bends do not allow for easy access to main lines, therefore these types of fittings are not allowed.
- G. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 6 inches above the roof.
- H. Flash the roof penetration with not less than 3 pounds per sq. ft. or 1.2 mm thick lead flashing approximately 24 inches square. Flange the flashing to the lead sleeve. Extend the flashing up and around the vent pipe. Turn the flashing down inside the pipe at least 2 inches to make a watertight joint. Flashing shall comply with the roofing manufacturer's requirements. Reference the Architectural Drawings for exact requirements.
- I. Locate vent piping through roof a minimum horizontal distance of not less than 20 feet from any air intake opening or supply fan

3.2 DOMESTIC WATER PIPE INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.
- B. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.
- C. Install water piping systems with uniform horizontal grade of 1/8 inch per 10 foot, minimum, to low points to provide complete system drainage. Where constant pitch cannot be maintained for long runs, establish intermediate low points and rise to new level. Grade branches to drain to mains or risers. Unless otherwise indicated, terminate low points of risers with drain valve piped to nearest hub or floor drain.

- D. Cover all domestic hot water piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3” wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with vapor barrier coating for chilled water piping applications.

3.3 UNDERGROUND WATER PIPING SYSTEM PROCEDURES

- A. Lay sewer and water lines in separate trenches, separated by 10 foot of undisturbed or compacted soil.

3.4 SANITARY SEWER TESTING

- A. Below Slab on Grade and All Floors in Multi-Story Buildings:
 - 1. Test pipe below slab on grade before backfilling and connecting to city sewers.
 - 2. Maintain not less than 10 feet of hydrostatic head for 1 hour without a leak.
 - 3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
 - 4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
 - 5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
 - 6. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.

3.5 DOMESTIC WATER TESTING

- A. Test under a cold water hydrostatic pressure per the State Plumbing Code and carefully check for leaks. Repair leaks and retest system until proven watertight and maintained for 6 hours.
- B. Use only potable water for the test.
- C. Perform the test before fixtures, faucets, trim or final connections are made to equipment.
- D. If the system is tested in sections, the entire domestic water piping system shall be submitted to a final test, employing the specified procedure.
- E. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- F. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.

- G. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.6 COPPER PIPE CORROSION PROTECTION

- A. Provide plasti-sleeve 0.006 thick corrosion protection on the copper tube piping systems in the building slab, beneath the building slab, and/or buried. Route plasti-sleeve the entire length of below slab on grade copper tubing.
- B. Extend the corrosion protection 6 inches above concrete slab on grade.

3.7 PLUMBING FIXTURE INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions.
- B. Make rough-in and final connection of service to each fixture provided under this Section and other Sections or Architectural or Plumbing Drawings.
- C. Provide necessary stops, valves, traps, unions, vents, cold water, hot water, sanitary, etc. for a complete installation.
- D. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibs, and where shown on drawings.
- E. Remove piping and services roughed-in incorrectly and install correctly, without cost.
- F. Exposed piping, fittings and appurtenances shall be chrome-plated brass.
- G. Coordinate with the Contractor for locations and service required for each plumbing fixture.

3.8 STERILIZATION

- A. Sterilize the water system with solution containing not less than 50PPM available chlorine. Allow chlorinating solution to remain in system for period of 8 hours (minimum). Have valves and faucets opened and closed several times during the period. After sterilization, flush the solution from the system with clean water until residual chlorine content is less than 0.2 parts per million.

END OF SECTION

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. General characteristics for pumps specified in Division 22 - Plumbing.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 22 - Plumbing, including the following:

- A. Division 22 Plumbing - Electrical Provisions of Plumbing Work.

1.3 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.

1.4 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.

- B. Submit copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.

1.5 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. Show pump curves with system curve plotted.

PART 2 - PRODUCTS

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS (Variable Speed) FRACTIONAL HORSEPOWER

- A. Pump Construction:
 - 1. Variable speed with automated ability to adjust and maintain optimum operating conditions Stainless steel housing
 - 2. Check Valve
 - 3. Flange or union connections
 - 4. Built in timer
 - 5. Built in temperature sensor
 - 6. Build in differential pressure sensor
 - 7. Programmable
- B. Acceptable manufacturers:
 - 1. Grundfos
 - 2. Armstrong
 - 3. Wilo

2.2 FLOW INDICATOR

- A. Flow Indicator
 - 1. Bronze Construction
 - 2. Rotating wheel
 - 3. Line Size
 - 4. Double Window
 - 5. Ernst Flow Industries Model EFI E-57-3

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
 - 1. Provide access space around pumps for service.
 - 2. Lubricate pumps prior to start-up.

3. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.
- D. Ensure pumps:
 1. Operate at specified system fluid temperatures without vapor binding and cavitation.
 2. Are non-overloading in parallel and individual operation.
 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.2 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
 1. Technicians, as required, shall be trained and experienced in the work they perform (Contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
 1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
 3. Submit readings for approval.
 4. Include the approved readings in the Owner's Maintenance Manual.

3.3 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
 1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
 2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.
- B. Enter the information on the final configuration of the pump in the Owner's Manual.
 1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.4 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
 - 1. A mechanical seal for each pump
 - 2. A set of bearings for each pump

END OF SECTION

SECTION 226311 - GAS PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install steel gas pipe inside buildings, including the supply line from the meter, service lines to gas equipment and appliances, termination of the service line with a plug valve, drip leg, and final connection to equipment and appliances with unions.
- B. Coordinate service line from utility main and extend to meter. Coordinate installation of the service line and meter with Gas Company.
- C. Extend steel gas piping from meter to inside the building to all fixtures, appliances and equipment requiring gas.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Plumbing Pipe and Fittings
 - 2. Valves and Vents

1.3 UTILITY CONNECTIONS

- A. Make arrangements for and pay all fees and connection charges for obtaining service to the building.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS - ABOVE GRADE

- A. Pipe 2 inch and Smaller:
 - 1. Schedule 40 ASTM A 53 black steel pipe
 - 2. Factory fabricated socket weld fittings.
- B. Pipe Larger than 2 inch:
 - 1. Schedule 40 ASTM A 53 black steel pipe.
 - 2. Factory fabricated butt weld fittings for welded steel pipes shall conform to ASTM A-234 WPB (seamless weld fittings).
- C. Unions:
 - 1. Standard 150 lb. (300 lb. water, oil or gas) malleable iron.
 - 2. Ground joint unions, with bronze seat.
 - 3. Flange joints for pipe larger than 2 inch in diameter.
- D. Flanges:
 - 1. Steel flanges. ANSI B16.5 and ASTM A-105.

2.2 PIPE AND FITTINGS - BELOW GRADE OUTSIDE BUILDING

- A. Polyethylene pipe shall be ASTM D3350 Grade PE24 cell classification and ASTM D1248 Class B material classification.
- B. Pipe shall be medium density polyethylene PE 2406 and PE 2708 manufactured by Poly Pipe Industries, Inc. or Performance Pipe.

- C. Polyethylene yellow molded butt fittings for use with medium density polyethylene pipe shall meet testing requirements of ASTM D2513 and resin material listing of ASTM D3350 with PPI designation of PE 2406 as manufactured by Central Plastics Co.

2.4 VALVES

- A. See Section 22 05 23.

2.5 GAS PRESSURE REGULATOR

- A. Size the gas pressure regulator in accordance with the manufacturer's recommendations for flow quantities and reduced pressure as required for all equipment. Coordinate final equipment gas pressure requirements prior to ordering regulators. Provide American Meter Company regulators or approved equal, suitable for outdoor installation. Regulators outside exposed to weather shall be installed with vent in vertical down position.
- B. All line pressure regulators shall be listed in accordance with ANSI (American National Standard) Z21.80.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation Standards: Install gas piping in accordance with recommendations of the National Fire Protection Association.
- B. Drip Legs: Install a capped drip leg 6 inches long at the base of each vertical rise.
- C. Coating and Wrapping. Coat and wrap underground piping in accordance with the service utility company standards.
- D. Sleeves.
 - 1. Encase gas piping running in or through solid partitions with thin wall metal conduit. Sleeve piping and fittings shall be two pipe sizes, but not less than 1 inch larger than encased gas piping.
 - 2. Encase gas piping running below slab in Schedule 40 PVC, minimum size two pipe sizes larger than gas pipe. Vent sleeve to atmosphere with a 1-1/2 inch vent with 1-1/2 inch return bend above building roof. Seal ends of sleeve with UL fire rated caulk.
- E. Do not install gas piping exposed to view inside public area, or occupied spaces, without prior written approval.
- F. Weld all gas piping above grade.
- G. Provide test ports and isolation valves to enable proper testing of system in the future.
- H. Provide isolation valve and unions across regulators for proper removal.
- I. Provide transition risers where below grade polyethylene pipe changes to steel pipe above grade.

J. Gas Pressure Regulators / Vents:

1. Piping shall be sized in accordance with the regulator manufacturer's instructions. Where there is more than one regulator at a location, each regulator shall have a separate vent to the roof / outdoors.
2. Install vent piping from regulators to location to prevent gas smells from entering building.
4. Install double elbows and insect screen at end of piping to prevent moisture and insects from entering.
5. When installed inside building route vents horizontally and terminate through building sidewall. Vents terminating through roof must have prior approval from Architect before installation. Through roof penetrations shall be minimized.
6. Regulators installed outside or on roof top: Install regulator vent turned downward with insect screen over vent opening. The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.

3.2 TESTING GAS PIPING

- A. Test joints with a soap solution while lines are under pressure.
- B. Repair leaks.
- C. Final gas test shall be with a 24 inch column of mercury or a diaphragm gauge with a minimum dial size of 3-1/2 inches with a set hand and a pressure range not to exceed twenty (20) psig with 2/10-pound increments. The minimum test pressure shall not be less than ten (10) psi and the maximum test pressure shall not exceed twelve (12) psig. This test will be observed for no less than (30) thirty minutes with no drop in pressure.
- D. Provide copy of gas pressure test reports in Operations & Maintenance Manual.

3.3 IDENTIFICATION CONDUCTOR

- A. Spiral A #12 AWG insulated copper conductor the full length of the thermoplastic piping system. Fasten to the pipe at 3 foot intervals with plastic tie wraps.
- B. Terminate at each end in a 12 inch x 12 inch x 4 inch FRP junction box.
 1. Bolted gasketed cover with stainless steel screws.
 2. Screw type terminal strip.
 3. Legend on cover "gas pipe identification conductor."
- C. Set in concrete pad.

3.5 PAINT EXPOSED OUTSIDE GAS PIPE

- A. Interior and Exterior Gas piping shall be protected from rust.
- B. Paint pipe with a flat alkyd coating, clean pipe prior to painting by preparing surface by hand tool cleaning per SSPC-SP2-82, applying one coat of Glidden Y-590 Rustmaster Metal Primer White and top coat of Yellow Alkyd Flat Enamel.

END OF SECTION

SECTION 230100 - HVAC OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit electronic copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer, bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Schedule of filters for each item of equipment.
 - 11. Schedule of belts for each item of equipment.
 - 12. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit completed manuals in final electronic form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.

- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Electronic copies of complete Manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.1 DIGITAL ORGANIZATION

- A. Use commercial quality digital document management systems with secure access.
- B. Ensure digital files are organized in a clear and systematic manner.
- C. When multiple digital folders are used, correlate the data into related groupings.
- D. Label contents clearly within the digital system, ensuring easy navigation and retrieval.

PART 3 - EXECUTION

- A. Form for Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typed.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List: a. Title of Project b. Identity of separate structures as applicable. c. Identity of general subject matter covered in the manual.
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address, and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address, and telephone number of:
 - 1) Subcontractor or installer.
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement.
 - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:

- 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.)
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds.
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems.
 1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts.
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions.
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer.
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Schedule of filters for each air handling system.

- k. Schedule of belts for each item of equipment.
 - l. Each Contractor's coordination drawings.
 - m. As installed color coded piping diagrams.
 - n. Charts of valve tag number, with location and function of each valve.
 - o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - p. Other data as required under pertinent sections of the specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
 - 4. Provide complete information for products specified in Division 23.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.
 - 9. Provide extended compressor warranty certificates.

END OF SECTION

SECTION 230500 - MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23 Mechanical.
- B. Applicable provisions of this section apply to all sections of Division 23, Mechanical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes, and regulations of governmental authorities having jurisdiction.
- B. Mechanical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction, or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws, and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments, or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum

for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of digital prints of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work where actual construction varies from the contract drawings. Mark the drawings digitally. Prepare, as the work progresses and upon completion, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under-slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of the project, obtain without cost to the Owner, digital copies of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of PDFs for each drawing, regardless of whether corrections were necessary, and include them in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built digital files is a condition of final acceptance. Provide record drawings in PDF format and Revit CAD files in electronic format.
- C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address, and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 6. Indicate exact location of all underground mechanical piping and elevation.
 - 7. Indicate exact location of all underground electrical raceways and elevations.
 - 8. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 9. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
 - 10. Exact location of all electrical equipment in and outside of the building.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces, or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment, or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts, or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 23 are used to establish standards of design, performance, quality, and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices, and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job-related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 AIR FILTERS AND PIPE STRAINERS

- A. Immediately prior to substantial completion of the project, inspect, clean and service air filters and strainers. Replace air filters.

3.3 LUBRICATION, REFRIGERANT AND OIL

- A. Provide a complete charge of correct lubricant for each item of equipment requiring lubrication.
- B. Provide a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify for proper operation as required.
- C. Provide a complete charge of special oil for refrigeration use, suitable for operation with refrigerant, in each system.

3.4 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted HVAC equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around duct penetrations or multiple pipe penetrations.

3.5 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 16 hours dedicated instructor time.
 - 2. 4 hours on each of 4 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.

- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.6 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, air handling units, fan coil units, fans, pumps, boilers, and cooling towers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.7 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.9 INDOOR AIR QUALITY

- A. All equipment and ductwork shall be installed to allow sufficient space for testing, maintenance, and commissioning functions. Access doors or panels shall be installed in ventilation equipment, ductwork, and plenum enclosures for inspection and cleaning of outdoor air intakes, mixing plenums, up and downstream of coils, filters, drain pans and fans.
- B. Practice source control and eliminate potential contaminants in material selection, installation, and maintenance.
- C. Provide installation and disposal instructions for all materials and chemicals that are potential contaminants.
- D. Obtain and conform to the requirements of the Material Safety Data Sheets (MSDSs) in the use of materials.
- E. Utilize manufacturer's recommendations and provide installation instructions for all chemicals, compounds, and potential contaminants including pre-installation degassing if required.
- F. Ventilate completed building prior to final completion using no less than design outside air for at least 48 hours before occupancy.
- G. Make provisions for controls to prevent the entry of air contaminants into the HVAC air distribution system.
- H. Steps shall be taken to ensure that the HVAC system continues to function effectively and are not damaged or contaminated during construction activities.

END OF SECTION

SECTION 230512 - HVAC SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by these specifications as outlined below.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}" = 1'-0"$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping

- 5. Fire protection piping and equipment
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation, and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, or NOT APPLICABLE. Explain all DO NOT COMPLY statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing, and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:

1. Field measurements
 2. Field construction criteria
 3. Manufacturer's catalog numbers
 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
1. Proper sizes and capacities
 2. That the item will fit in the available space in a manner that will allow proper service
 3. Construction methods, materials, and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
1. Date
 2. Project title and number
 3. Contractor's name, address and contact number.
 4. The number of each Shop Drawing, Project Datum and Sample submitted
 5. Other pertinent data

- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 230513 - ELECTRICAL PROVISIONS OF HVAC WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for mechanical equipment.
 - 2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
 - 5. Wiring of smoke detectors for shutdown of air handling equipment when a fire alarm system is not included in the project.
 - 6. Wiring of oil pump, vibration, and oil level limit switches for cooling towers.
 - 7. Refrigerant monitor/sensor/alarming and field installed visual/audible display alarms.
 - 8. Pipe heat tracing.
 - 9. Cooling tower vibration switch/interlock/reset.
 - 10. Field interlock wiring from cooling tower: flow switches, pump aux. Contacts, pump start/stop.
 - 11. Power supply 120 VAC and control signal from chiller control panel to condenser water flow control valve installed in piping leaving chiller.
 - 12. Wiring of all related circulating water system chemical treatment devices.
 - a. Low voltage electric contacting water meter
 - b. Solenoid valve/blow-down assembly
 - 13. Radiant heater timer switches and/or thermostats
 - 14. Low Voltage thermostat wiring
- C. Refer to Division 23 Controls Sections for related control system wiring.
- D. Refer to Division 23 sections for specific individual mechanical equipment electrical requirements.
- E. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment.
- F. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.1 MOTORS

- A. Provide motors for mechanical equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
 - 9. WEG
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of mechanical equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of mechanical work:
- C. Temperature Rating. Rated for 40 Degrees C environment with maximum 50 Degrees C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with

individual equipment requirements specified in other Division 23 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.

- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regrease-able except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 - 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 23 for other enclosure requirements.
 - 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 - 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.
- I. Provide an inverter duty motor on all equipment that utilizes a variable frequency drive.

2.2 EQUIPMENT FABRICATION

- A. Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings, and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

2.3 GENERAL REQUIREMENTS – SHAFT GROUNDING RINGS

- 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. Application Note: Motors up to 100 HP shall be provided with one shaft ground 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's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION

SECTION 230514 - HVAC CONDENSATE DRAIN PIPING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide and install air conditioning condensate drains.

1.2 RELATED WORK

- A. Division 23 - Mechanical
 - 1. Insulation
 - 2. Fan/Coil Units
 - 3. Air Handling Units
 - 4. Chilled Water Pumps
 - 5. Equipment Drain Pans
 - 6. Heat Pump Units

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

- A. Type "L" copper with drainage pattern fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the system to facilitate easy removal.
 - 1. Use threaded plugged tee at each change of direction to permit cleaning.
 - 2. Install a cleanout every 50 feet of straight run piping
 - 3. Maintain a positive slope on all piping
- B. Install a water seal trap leg based on the fan pressure.
 - 1. Size the length of the trap leg 1 inch larger than the actual system pressure.
- C. Install traps and cleanout as shown in the drawing details.
 - 1. Confirm requirements with manufacturer's installation instructions

3.2 SIZE PIPE AS SHOWN ON DRAWINGS.

- A. Do not install piping sized smaller than the unit drain connection size.

3.3 SECONDARY DRAINS

- A. Provide secondary drains where required by code, shown on the drawings, or where equipment has secondary drain connections.

END OF SECTION

SECTION 230517 - HVAC ACCESS DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, fire dampers, air distribution devices and other equipment requiring maintenance, adjustment, or operation.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Flush screwdriver cam lock & cylinder lock for Owner selection
- E. Automatic closing and latching mechanism
- F. Prime coat finish
- G. Brushed satin stainless-steel finish for restroom or kitchen.
- H. Material suitable for wall and/or ceiling mounting

2.2 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2-hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic closing and latching mechanism
- G. Knurled knob and recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish

- J. Material suitable for wall and/or ceiling mounting

2.3 ACCEPTABLE MANUFACTURERS

- A. Milcor
- B. MIFAB
- C. Acudor
- D. Elmdor

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Access doors specified in Division 23 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 36" x 24" for Mechanical HVAC equipment related items
 - 2. 18" x 18" for electrical related items

END OF SECTION

SECTION 230518 - VARIABLE FREQUENCY INVERTER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a variable frequency inverter for the following equipment items.
 - 1. Roof Top Air Handling Units.
 - 2. Pumps.
 - 3. Cooling Towers.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Electrical Provisions of Mechanical Work.
 - 2. Air Handling Units
 - 3. Pumps
 - 4. Cooling Towers
 - 5. Building Management Control System Sequences

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical to ensure that intended functions are achieved.
- B. Coordinate the size of the variable frequency inverter with the equipment being served by the inverter. The rated current output amps are to be equal to or greater than motor rated full load amps.

1.4 SUBMITTALS

- A. Submit manufacturer's information and shop drawings as specified.
 - 1. Complete technical details.
 - 2. Dimensions and manufacturer's installation manual.
 - 3. Schematic diagrams of the circuitry and field connections.
 - 4. Manufacturer's start-up manual.

1.5 STANDARDS

- A. UL.
- B. CSA.
- C. ISO 9001
- D. NEC.
- E. FCC.

1.6 WARRANTY

- A. The manufacturer shall provide a full parts and labor warranty for a period of five (5) years from substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. ABB
- B. EATON
- C. Yaskawa

2.2 CABINET

- A. The inverter and all accessories shall be provided within a wall mounted UL Listed NEMA 1 enclosure in interior AHU mechanical rooms and in NEMA 12 enclosure with dead sides and removable hinged, gasketed doors with provisions for locking in all Plant locations. Cabinet shall be constructed of metal for reduction of radio frequency interference (RFI) and electromagnetic frequency interference.

2.3 INTERFERENCE WITH OTHER SYSTEMS

- A. The inverter shall be designed and constructed to comply with IEEE Standard 519-1993 with respect to line noise and RFI generation. All units shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in Table 1.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.
- B. Dual DC Bus filtered chokes (factory installed and wired in the drive enclosure) equivalent to 5% input line reactors shall be provided to minimize harmonics reflected onto the input line.
 - 1. Shall not interfere with computer and other electronic systems in the building.
 - 2. If not inherently protected, provide a suitable isolation transformer.
 - 3. The system shall not produce spikes on the incoming line.
- C. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.

2.4 PROTECTIVE CIRCUITS

- A. Provide the following protection:
 - 1. Input line fuses or molded case circuit breaker rated at 100 AIC.
 - 2. Input line noise suppression with MOV's (metal oxide varistors) and snubber circuits. MOV's shall be provided across incoming line terminals, AC input

- reactors, DC choke filters, and transistors to protect inverter from voltage surges and spikes.
3. Protection of solid-state inverter devices by limiting output current to 110% of inverter rating, automatically prevent overcurrent trip due to momentary overload conditions.
 4. Current limiting DC buss fuse between input and output sections of inverter.
 5. Input overvoltage trip at 480 vac + 10% trip.
 6. Input undervoltage at 480 vac – 10% trip
 7. Instantaneous overcurrent protection of solid-state inverter devices.
 8. Individual overcurrent protection of solid-state inverter devices.
 9. Output overvoltage trip.
 10. Loss of input phase, phase reversals, or blown fuse.
 11. Thermal overload trip for overload protection of solid-state devices.
 12. Ground fault protection on start-up.
 13. Output line to line short circuit protection.
 14. Phase to phase short circuit or severe overload conditions of output.
 15. Overload of motor.
 16. Frequency stall.
 17. DC buss high voltage.
 18. Control function error.
 19. Heatsink over temperature (Max. operating ambient: 122 degrees F)
 20. Controller able to operate without a motor or any other equipment connected to the output (To facilitate startup and troubleshooting).
 21. Capable of restarting into a rotating motor without component damage.
 22. Shut down safely without component failure in the event of a sustained power loss, and will automatically return to normal operation, if start is "on" and power is restored.
 23. Shut down safely without component failure in the event of a momentary power loss. Automatically return to normal operation if the start is "on", and normal power is restored. Capable of establishing speed control without shutdown or component failure.
 24. Designed for input power contactor opening or closing while control is activated, without damage to the controller.
 25. Automatically reset trip resulting from overcurrent, undervoltage, overvoltage, or over temperature, and automatically restart after removal, or correction of the faulty condition.
 26. Provide status lights or digital display for indication of failure conditions, and form C relay provided for remote indication. Digital display or status lights to indicate power on, at speed, and drive enabled.
 27. Operation and fault diagnostic function circuits shall be built into each inverter that provides information in determining the cause and source of a fault.
Diagnostics to provide the following information:
 - a. Operating mode at trip (Accel, Decel, Constant speed).
 - b. Output current at trip.
 - c. Output voltage at trip.
 - d. Additional faults that occurred simultaneously or immediately before displayed tripped.Any drive requiring separate card to provide this information shall provide a diagnostic card for each drive.
 28. DC link reactor.
 29. Input power disconnect, lockable type.

30. Input power disconnect switch / circuit breaker, with lockable type handle.

2.5 OPERATOR DEVICES

- A. The following operator devices shall be door or remote mounted:
 1. Digital keypad and LCD provided to perform all parameter adjustments, operation monitoring, and operation programming.
 2. Power on indication light.
 3. Flush mounted meters or digital display to indicate output voltage, output frequency, and output current, in percent of maximum 0 to 100%.
 4. Manual/Off/Auto 3 position selector switch (hand-off-auto) and manual speed setting control to provide the following control sequences:
 - a. In automatic mode, controller shall follow an external control signal and respond to remote start-stop contact.
 - b. In manual (hand) mode, controller shall follow speed signal set via door mounted keypad and start/stop switch. Switching from "hand" to "auto" and vice versa shall require a single keystroke to a dedicated changeover key. Inverters requiring multiple keystrokes and/or reprogramming of internal parameters to accomplish changeovers are not acceptable.
 - c. An integral "safety interlock" protection shutdown circuit shall be provided for interface with fire-stats, smoke detectors, high static pressure limit switches, vibration switches, etc.
 5. Programmable lockout code to prevent unauthorized programming.
 6. Critical frequency avoidance capability (up to 3 resonant points).

2.6 FIELD ADJUSTMENTS

- A. The following shall be adjustable in the field:
 1. Maximum Speed: 0 to 125% adjustable.
 2. Minimum Speed: 0 to 100% adjustable.
 3. Acceleration/deceleration rates: 0 to 3600 sec.
 4. Instantaneous overcurrent trip: 50% to 2000%.
 5. Volts/hertz ratio: Field adjustable to 16 patterns or set for automatic selection of proper V/F load profile to operate motor without overdriving or overloading.
 6. Current limit circuit: 60 to 100%.
 7. Carrier frequency: 6 to 16 KHZ.
 8. Control interface: selectable to follow a 0-5 VDC, 0-10 VDC, 4-20 MA, either direct or indirect acting.
 9. Control signal Bias: 0 to 80 HZ.
 10. Control signal gain: 0 to 80 HZ.
 11. Calibration of remote speed signal: 0 to 80 HZ.

2.7 ELECTRICAL CONSTANT SPEED BYPASS

- A. Provide all components and circuitry necessary to provide manual bypass of the inverter. The bypass package shall be mounted in a cabinet common with the inverter and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode. Manual bypass shall contain the following:
 1. Two contactors mechanically interlocked via a three position through the door selector switch to provide the following control:
 - a. "Inverter" Mode connects the motor to the output of the inverter.

- b. "Bypass" Mode connects the motor to the input sine wave power. Transfer must occur with input disconnect open. Motor is protected via thermal overload.
 - c. "Off" Mode disconnects motor from all input power.
- 2. A molded case circuit breaker or fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
- 3. An input contactor, interlocked with both the thermal motor overload and external safeties which disconnects power to the motor regardless of the mode of operation (either "inverter" or "bypass" mode).
- 4. A thermal overload to provide protection of motor in the bypass mode.
- 5. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation – "inverter" or "bypass") in response to a signal from the thermal overload and/or external safety circuits.
- 6. Line voltage to 24-volt DC power source, fused per NEC, shall provide power to all bypass control circuits.

2.8 SERIAL COMMUNICATIONS

- A. The VFD shall have the capability of communicating with the EMS control system via an RS-485 serial port.
- B. VFD shall be provided with protocol information specific to the selected EMS control manufacturer and shall be pre-configured at the factory to automatic communications, without the need for field programming.
- C. Serial communications capabilities shall be included, but not limited to; run/stop control, speed set adjustment, proportional/integral or PID control adjustments, current limit and accel/decel time adjustments. The drive shall also have the capability of allowing the DDC system to monitor the following feedback signals; process variable, output speed/frequency, current, torque, power (KW), operating hours, kilowatt hours, relay outputs, and diagnostic warning and fault information.
- D. The VFD shall allow the DDC system to control the drive's digital and analog outputs and monitor all drive digital and analog inputs via the serial interface.
- E. Provide BACnet interface card.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation as per manufacturer's recommendations and requirements.
 - 1. Inverter chassis is properly grounded.
 - 2. Line, Load, Control, and Fire/Safety wiring are installed in separate conduits.
 - 3. Both ends of conduit entering and leaving VFD into AHU cabinets and motors must be sealed airtight.

3.2 MANUFACTURER START-UP SERVICE

- A. Factory trained personnel shall be provided for start-up assistance, minimum (1) day per unit.
 - 1. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents.
 - 2. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
 - 3. Adjustable devices, components, and assemblies to assure optimum performance.
 - 4. Make final adjustments to the installed drive to assure proper operation of the fan system. Obtain performance requirements from installer of driven loads.
 - 5. Assistance will be provided to the Owner (upon request) to determine the optimum capacitance for per factory correction and avoidance of potential resonance problems and will determine optimum line filter required.
 - 6. A written report, duly signed by the technician detailing set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.
- B. Input DC voltage to dry motor windings when fan is not in operation at the following locations:
 - 1. Cooling tower fan motor
 - 2. Motors downstream of coils
 - 3. Rooftop unit motors

3.3 DEMONSTRATION AND TRAINING

- A. Provide system demonstration to personnel, Owner, and/or Owner's selected representatives.
- B. Demonstrate operation of controllers in the automatic and manual modes.
- C. Provide a minimum of two days of technical training for the owner's operating and technical staff. Schedule training with owner's authorized representatives, during normal business hours and not less than 30 days prior to planned session.
- D. Training may be consecutive or random, at Owner's option.

END OF SECTION

SECTION 230519 - HVAC PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.2 RELATED WORK

- A. Division 23, Mechanical
 - 1. 230500 - Mechanical General Provisions
 - 2. 232000 - Pipe and Pipe Fittings, General
 - 3. 230523 - Valves, Strainers, and Vents
 - 4. 232113 - Hot Water Piping, Valves and Appurtenances
 - 5. 232124 - Condenser Water Piping, Valves and Appurtenances

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

- A. Trerice
- B. Taylor
- C. Marsh
- D. Weksler
- E. Marshalltown
- F. Weiss
- G. Miljoco

2.2 PRESSURE GAUGES

- A. Case and Ring: 4" type 304 stainless steel; liquid filled case with stainless steel bayonet ring.
- B. Dial: White aluminum with black markings
- C. Window: Clear acrylic
- D. Tube: Phosphor bronze and forged brass socket.
- E. Gauge accuracy: +/- 1% over operating range.

- F. For pulsating service, provide impulse dampers.
- G. Without flange for pipe mounting.
- H. With flange for wall mounting.
- I. Weiss Model: LF44S-1B or equal.

2.3 THERMOMETER WELLS

- A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
- B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
- C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
- D. Wells shall be sized to extend a minimum of 50% into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

- A. Die cast aluminum case with baked epoxy finish.
- B. Adjustable angle 9" scale length.
- C. Clear acrylic window.
- D. Brass stem, length to match well.
- E. Red reading organic spirit filled-in magnifying glass column.
- F. White background with black figures and markings.
- G. Brass stems and union connections.
- H. Accuracy: +/- 1% of scale range.
- I. Range:
 - 1. Hot water lines: 30°F to 240°F.
 - 2. Condenser water: 0°F to 100°F.

2.5 PRESSURE AND TEMPERATURE TEST STATIONS

- A. "Test Station" fitting to receive either a temperature or pressure probe. Fitting shall be solid brass with two valve cores of Nordel.
 - 1. Fitted with a color-coded cap strap with gasket.
 - 2. Acceptable Manufacturer: Peterson Equipment Company.
 - 3. Provide with extension neck to match insulation thickness.
- B. Provide to the Owner a fitted case with:

1. Two 0-100 psi pressure gauges as specified and adapters with 1/8" OD probe.
2. Four 5" stem pocket testing thermometers.
 - a. Two with range 25°F to 125°F for condenser water.
 - b. Two with range 0°F to 220°F for hot water.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with drawing details and manufacturer's recommendations.
- B. Provide a ball valve at each gauge.
- C. Locate gauges and thermometers to be easily readable from the floor at a 5'-6" eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.
- D. Install gauges in the following locations: across pumps, chiller cooler and condenser, storage tanks, heat exchangers.
- E. Test wells for automatic temperature controls shall be furnished by Building Management Control Section and installed by Mechanical Contractor.
- F. Install thermometer in the following locations: Across chiller cooler and condenser, storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, common chilled and hot water lines.
 1. Hot water lines: 30°F to 240°F.
 2. Condenser water 0°F to 100°F.

END OF SECTION

SECTION 230520 - FLOW METERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install flow meters. This Specification applies to Division 23. Flow meters for control functions are specified in the Controls Section and are to be supplied under the work of that Section.

PART 2 - PRODUCTS

2.1 FLOW ELEMENTS

- A. Provide and install annular elements, complete with bar stock valved connections for piping to flow transmitter. Furnish quick-disconnect valves and bar stock shutoff valves for connection to portable meter. Construct elements of 316 stainless steel. Provide annubars manufactured by Ellison or equal.
- B. Furnish a metal identification tag and chain giving pipe size, design flow rate, meter reading at design flow rate, metered fluid, and station number.
- C. For station sizes 1/2" through 1-1/2", use Ellison 71 nipple section type. For station sizes 2" and larger, use Ellison 73 or 75 standard insert type.
- D. Select flow sensors so that the design flow rate occurs between 10 and 40" of water pressure differential with permanent pressure loss of not more than 5" of water. An accuracy of plus or minus 2.5% of actual flow rate from 40 to 120% of design flow rate is required.
- E. Acceptable Manufacturers:
 - 1. Taco.
 - 2. Paco.
 - 3. Annubar.
 - 4. Preso.
 - 5. Barco.
 - 6. BIF.
 - 7. Venturi.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with Manufacturer's written instructions.

END OF SECTION

SECTION 230523 - HVAC VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. HVAC Valves
- B. Pipe strainer and suction diffusers.

PART 2 - PRODUCTS

2.1 VALVES

- A. Pressure Ratings:
 - 1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450°F.
 - 2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.
- B. Butterfly Valves
 - 1. Butterfly valves shall conform to MSS-SP67.
 - 2. Liners, inserts and discs shall be suitable for the intended service.
 - 3. Valves shall have a full lug type body designed for installation between ANSI standard flanges and shall be rated at full working pressure with downstream flange removed.
- C. Balancing Valves
 - 1. Provide balancing valves with:
 - a. Corrosion resistant plug with resilient seal when required.
 - b. O-ring stem seal.
 - c. Permanently lubricated, corrosion resistant bearings.
 - 2. Connections
 - a. Through 2" pipe size use threaded connections.
 - b. For valves 2-1/2" pipe size and larger shall be provided with 150 psig flange connections.
 - 3. Provide each valve with:
 - a. Memory stop.
 - b. Plastic drip cap.
 - c. 1/8" gauge tap.
- D. Ball Valves
 - 1. Provide ball valves with:
 - a. Blowout proof stem.
 - b. Full size port, 316 stainless steel ball and stem.
 - c. Cast bronze body.
 - d. Threaded ends.
 - 2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
 - 3. Service rating:
 - a. 150 psi saturated steam.

- b. 600 psi WOG.
 - 4. Where piping is insulated, ball valves shall be equipped with 2" extended handles of non-thermal conductive material. Provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.
 - 5. Provide with memory stop for balancing valves.
- E. Valve Connections
 - 1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
 - 2. Thread pipe sizes 2" and smaller.
 - 3. Flange pipe sizes 2-1/2" and larger.
 - 4. Use screw to solder adapters for copper tubing.
 - 5. Use grooved body valves with mechanical grooved jointed piping.
- F. Valve Operators
 - 1. Where butterfly valves are provided:
 - a. Provide gear operators on valves 6" and larger.
 - b. Where valves are located 7' or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5' above floor and hook to clips, arrange to clear walking space.
 - c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4" and smaller.
 - d. Provide worm gear operators on discharge side of pumps for balancing, for all sizes of valves.
 - e. All valves 2-1/2" and larger provided by Milwaukee Valve shall be provided with gear operators.
- G. Acceptable Manufacturers
 - 1. Dezurik
 - 2. Crane
 - 3. Nibco
 - 4. Keystone
 - 5. Milwaukee Valve
- H. Check Valves
 - 1. Bronze body, 2" and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection.
 - 2. Iron body, 2-1/2" and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug.
 - 3. Acceptable Manufacturers
 - a. Mission Duocheck
 - b. Nibco
 - c. Keystone
 - d. Milwaukee Valve
- I. Provide valves of same manufacturer throughout where possible.

- J. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.
- K. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.
- L. Provide valve, seat, and trim materials suitable for the intended service.
- M. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, caged or ball type.
- N. Condenser Water Basin Float Valve:
 - 1. Ductile Iron valve, body, and cover
 - 2. Stainless steel trim
 - 3. Fully adjustable high- and low-level settings
 - 4. Stainless steel float, float linkage and float rod
 - 5. Flow clean strainer
 - 6. CV Flow Control for opening and closing
 - 7. ASTM A 536, B16.42, 150# Class
 - 8. Stilling well
 - 9. Acceptable Manufacturer: CLA-VAL

2.2 PIPE SYSTEMS STRAINERS

- A. Body:
 - 1. "Y" pattern or basket as shown on the drawings.
 - 2. Line size.
 - 3. Threaded strainer blow-down port.
 - 4. ASTM A #126 Class B Cast Iron Body.
- B. Construction:
 - 1. 2" size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2" size with flanged connections, rated 125 psi WOG.
- C. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2".
 - 2. With 0.45 perforations in piping systems 2-1/2" and 3".
 - 3. With 0.125 perforations in piping systems 4" and larger.
- D. Start-up:
 - 1. Provide an additional fine mesh disposable screen for use during start-up operations.
 - 2. Remove after 30 days.
 - 3. Attach to piping for owners' review.
- E. Acceptable Manufacturers
 - 1. Crane
 - 2. Keckley
 - 3. Zurn
 - 4. Mueller
 - 5. McAlear

6. Muesco

2.3 SUCTION DIFFUSER

- A. For each pump as shown on the drawing, provide an angle type suction diffuser. Body is to fit both the pump inlet and suction pipe size.
- B. Components:
 - 1. Inlet straightening vanes.
 - 2. Removable end cap.
 - 3. Gauge ports.
 - 4. Threaded strainer blow-down port.
 - 5. Adjustable support foot.
 - 6. Removable magnetic insert.
- C. The screen shall be as specified for pipe system strainers.
- D. Provide an additional fine mesh disposable strainer for use during start up operations.
 - 1. Remove after 30 days operation and all flushing is complete.
 - 2. Attach to piping for owners' review.
- E. Construction:
 - 1. 2" size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2" size with flanged connections, rated 125 psi WOG.
- F. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2".
 - 2. With 0.045 perforations in piping systems 2-1/2" and 3".
 - 3. With 0.125 perforations in piping systems 4" and larger.

2.4 VALVE SCHEDULE

- A. Hydronic Service
 - 1. Chilled Water Service
 - a. Ball Valves up to 2": Nibco T-585-70-66 w/Nib-Seal insulated Handle
 - b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
 - 2. Heating & Condenser Water Service
 - a. Ball Valves up to 2": Nibco T-585-70-66
 - b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
 - 3. Check Valve:
 - a. Nibco Check Valve: T - 413 - B
 - b. Nibco Check Valve 2-1/2" and larger: F - 918 - B
 - c. Nibco Check Valve 2-1/2" and larger: W - 920 -W (Wafer)
 - d. Keystone Check 2-1/2" and larger: FIQ 810

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.
- C. Use butterfly valves and ball valves in circulating water systems, for balancing duty. Provide infinite position gear operator with memory stop.
- D. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
 - 1. 1" valve for pipes 6" and larger.
 - 2. 3/4" valve for pipes smaller than 6".
 - 3. Terminate with pipe plug.
 - 4. Drain valves shall be ball valves.
- E. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.
- F. Provide clearance for installation of insulation and access to valves.
- G. Provide access where valves are not exposed.
- H. Provide float valves / stilling wells in cooling tower or condenser water basins for water level control. Provide stilling wells around float valve to prevent turbulence ripples or wind interference.
- I. Butterfly valves shall be installed per ASME B31.3 Process Piping, and ASME B16.5 Pipe Flanges and Flanged.

3.3 PIPE SYSTEMS STRAINERS

- A. Provide an additional fine mesh disposable strainer for use during start up operations.
 - 1. Remove after 30 days operation and all flushing is complete.
 - 2. Attach to piping for owners' review.
- B. Provide strainer in supply piping for all coil connections.
- C. Provide strainer in condenser water piping entering chiller.

3.4 WATER SYSTEM AIR VENTS

- A. Provide manual air vents at high points and at any other air pockets of closed circulating pipe systems. Extend 3/8" hard drawn copper tubing discharge drains to nearest floor or hub drain. Provide 1/4" Ball Valve as specified.

- B. Where high point vents are not readily accessible provide additional valves at vent termination.

END OF SECTION

SECTION 230533 - HVAC PIPE HEAT TRACING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete industrial, constant wattage, UL listed system of electric pipe heat tracing and controls on all make-up water piping outdoors above grade to prevent freezing. The heat tracing system shall conform to ANSI/IEEE Standard 515-1989.
- B. Protect the pipe, valves, fittings, meters and appurtenances. Apply sufficient cable and overheat thermostat to protect the entire system.

1.2 SUBMITTALS

- A. Submit shop drawings and product data as specified in Section 23 05 12
- B. Submit detailed calculations for length of heat tracing cable per foot of pipe, based on actual length of piping installed.
- C. Submit manufacturer's certified capacity charts with selections plotted thereon.
- D. Submit manufacturer's installation instructions.
- E. Submit full load ampere requirement and voltage for branch circuit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Raychem Corporation
- B. Thermon Manufacturing Company

2.2 COMPONENTS

- A. Self-regulating heater.
 - 1. The self-regulating heater shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed itself without overheating and to be cut in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.
 - 2. In order to provide energy conservation, and to prevent overheating, the heater shall have a self-regulating factor of at least 90%.
 - 3. The heater shall operate on a line voltage of 120 VAC without the use of transformers.
 - 4. The heater shall be sized according to the following. The required heater output rating is in watts per foot at 50°F (heater selection based on 1-1/2 inch fiberglass insulation on metal piping).

5. The heater shall be XL-Trace as manufactured by Raychem Corporation or XL-Econotrace as manufactured by Thermon Manufacturing Company.
6. Power connection, end seal, splice and tee kits components shall be applied in the field.
7. The system shall be controlled by an ambient sensing thermostat set at 40°F either directly or through an appropriate contactor.
8. Provide an end-of-circuit voltage indicating light

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and start up the pipe heat tracing system in accordance with the manufacturer's Installation, Start-up and Service Instructions.
- B. Install the pipe heat tracing cable under the pipe insulation.
- C. Apply “Electrically Traced” signs to the outside of the thermal insulation.
- D. Ground fault protection of the equipment shall be provided per the 1996 National Electrical Code, Article 427-22.
- E. Provide a cast aluminum weatherproof NEMA-4 rated junction box for installation of the cable, with pilot light to indicate operation of the cable.
- F. Use only electrical components as recommended by the manufacturer.

3.2 ELECTRICAL WORK

- A. Furnish and install the wire, conduit and raceway systems required for the automatic operation of the pipe heat tracing system. Conform to the National Electrical Code.
- B. The specified wiring work includes:
 1. Wiring of control instruments between thermostat and junction boxes
 2. Installation of thermostat and junction boxes
 3. Wiring from the heat tracing cable to the junction boxes
- C. Related branch circuit power wiring from the junction box to ground fault type circuit is specified to be provided in Division 26.
- D. Provide devices and appurtenances as specified in Division 26.
- E. Identify each circuit at each terminal with a separate tag.
- F. Color code wires in accordance with IPCEA Standards.
- G. Make all joints and connections with approved mechanical connectors.

3.3 TESTING OF THE PIPE HEAT TRACING SYSTEM

- A. Test the pipe heat tracing system:
 - 1. Simulate freezing outside air conditions
 - 2. Measure the amperage draw of the heat tracing system
 - 3. Compare to the manufacturer's capacity rating of the actual system
 - 4. After installation and before and after installing the thermal insulation, subject heat to testing using a 1000 VDC megger. Minimum insulation resistance should be between 20 to 1000 megohms regardless of the length.
- B. Submit records of test for approval prior to substantial completion; insert in the Owner's Manual.

END SECTION

SECTION 230548 - VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish, install, and adjust vibration isolation.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Refer to the Section on Ductwork for flexible connections between fans and ducts.
 - 2. Refer to the Section on Equipment Supports for equipment foundation pads.

1.3 SUBMITTALS

- A. Submit product data showing type, size, load, deflection, and other information required. Include clearly outlined procedures for installing and adjusting isolators.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Amber Booth
- B. Kinetics
- C. Mason
- D. Korfund
- E. VSI.
- F. Vibration Eliminator Co., Inc.
- G. Metraflex

2.2 ISOLATOR TYPES

- A. Neoprene mountings shall have a minimum static deflection of 0.35 inches (9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.
- B. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or ¼ inch (6mm) neoprene acoustical friction pad between the base plate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

- C. Hangers shall consist of rigid steel frames containing minimum 1-1/4 inch (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification B seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- D. Hangers shall be as described in D, but they shall be pre-compressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.
- E. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating concrete bases. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches (150mm). The base depth need not exceed 12 inches (300mm) unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch (12mm) bars welded in place on 6 inch (150mm) centers running both ways in a layer 1-1/2 inch (40mm) above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1-inch (25mm) clearance below the base. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable.
- F. Flexible spherical expansion joints shall employ Peroxide cured EPDM in the covers, tubes and frictioning of the reinforcement. Reinforcement must be DuPont Kevlar. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. No substitutions for the DuPont Kevlar or the solid steel embedded flange rings are acceptable. Sizes 2 inch (50mm) and larger shall have two spheres reinforced with a metal ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16 inch (400mm) to 24 inch (600mm) may be single sphere. Sizes 3/4 inch (20mm) to 1-1/2 inch (40mm) may have threaded bolted flange assemblies, one sphere and cable retention. 14 inch (300mm) and smaller connectors shall be rated at 250 psi (17 BAR) up to 190°F (88°C) with a uniform drop in allowable pressure to 190 psi (13 BAR) at 250°F (121°C). 16 inch (400mm) and larger connectors are rated 180 psi (12 BAR) at 190°F (88°C) and 135 psi (9 BAR) at 250°F (121°C). Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5-minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.

High pressure joints shall be substituted for the above where operating pressures are higher than standard. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. Control rods are not desirable in seismic work. If control

rods are used, they must have ½-inch (12mm) thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi (6.9 N/mm²) maximum on the washer area. Standard diameter bolt washers are not acceptable.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves.

- G. Flexible stainless-steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3 inch (75mm) and larger shall be flanged. Smaller sizes shall have male nipples. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.
- H. Split Wall Seals consist of two bolted pipe halves with minimum ¾-inch (20mm) thick neoprene sponge cemented to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall, or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1 inch (25mm) past either face of the wall. Where temperatures exceed 240°F (115°C), 10 lb. density fiberglass may be used in lieu of the sponge.
- I. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2-inch (12mm) thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of $\pm 1\text{-}5/8$ -inch (42mm) motion, or to meet location requirements.
- J. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind forces. All directional neoprene snubber bushings shall be a minimum of 1/4 inch (6mm) thick. Steel springs shall be laterally stable and rest on 1/4 inch (6mm) thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2 inches (50mm) of insulation.

*DELETE AHU IF AHUS ARE INTERNALLY ISOLATED.

2.3 ISOLATOR APPLICATION

EQUIPMENT	ISOLATOR TYPE	MINIMUM DEFLECTION
Water Source Heat Pump Air Handling Units - Suspended	C	1"

EQUIPMENT	ISOLATOR TYPE	MINIMUM DEFLECTION
Cooling Towers	A	0.35"
Pump (Above Grade)	B & E	1.5"
Suspended Fan Coil Units	C	0.5"
Condensing Units	A	0.35"
In-Line Fans	C	0.5"
Roof Mounted HVAC Equipment	J	2"

2.4 PIPING ISOLATOR APPLICATIONS

EQUIPMENT	ISOLATOR TYPE
Floor Mounted Pumps	F
Suspended Pumps	F
Cooling Tower Pipe Connections	F

2.5 FLEXIBLE CONNECTIONS IN PIPING AT PUMPS

- A. Provide flexible connections at suction and discharge of chilled water, and hot water pumps, piping connections on cooling towers and where indicated on drawings. Refer to schedule above.

2.6 PIPING

- A. Provide a floating piping system in the central plant and in all mechanical rooms.
- To create a floating pipe system, install pipe hangers at regular intervals according to the pipe hanger schedule.
 - Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping and yet, to permit piping to function as a floating system.
 - Size hangers for 200% rated load.
 - Size isolators for a minimum of 1-inch static deflection.
 - Provide Type C or D spring hangers and Type B support isolators. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Stock Requirements. The isolation manufacturer's representative shall maintain an adequate

stock of springs and isolators of type used so that changes required during construction and installation can be made.

- B. Factory Representation. After installation, furnish factory-trained representative of the isolation manufacturer to check various isolators and report measured versus anticipated deflection on all isolators. Have the representative certify that isolators have been installed in accordance with manufacturer's recommendations and approved submittals. Provide written report to Engineer indicating compliance prior to final acceptance.

END OF SECTION

SECTION 230593 - TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL
SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Balance, adjust and test the air distribution system including the exhaust system.
- B. Balance, adjust and test the hydronic system.
- C. Verify and record the duct test results performed by the mechanical contractor.

1.2 RELATED SECTIONS

- A. COORDINATION OF TESTING AND BALANCING

1.3 PAYMENT PROCEDURES

- A. The work of this Section of the Specifications shall bid the project directly to the General Contractor.

1.4 SUBMITTALS

- A. History of the TAB organization.
- B. Agency certification.
- C. Personnel qualifications.
- D. TAB data forms.
- E. Instrumentation list.
- F. Name of the project supervising engineer.
- G. Name and address and contact person of five successfully completed projects of similar size and scope.
- H. To perform required professional services, the balancing agency shall have a minimum of one test and balance engineer certified by the Associated Air Balance Council.

1.5 TAB FIRM QUALIFICATIONS

- A. The organization performing the work shall be a Certified member in good standing of the (AABC) Associated Air Balance Council.

- B. Able to furnish evidence of having contracted for and completed not less than five systems of comparable size and type that have served their Owners satisfactorily for not less than five years.
- C. A specialist in this field and have the personnel, experience, training, skill, and the organization to perform the work.
- D. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the engineer to determine the balancing agency's performance capability.
- E. The balancing agency shall have operated for a minimum of five years under its current name.
- F. Personnel:
 - 1. The project supervisor shall be a Professional Engineer registered in the state the work shall be performed.
 - a. Extensive knowledge of the work involved.
 - b. At least five years experience conducting tests of the type specified.
 - c. This test and balance engineer shall be responsible for the supervision and certification of the total work herein specified.
 - 2. All work shall be conducted under the direct supervision of the supervising engineer.
 - 3. Technicians shall be trained and experienced in the work they conduct.

1.6 WARRANTY

- A. Provide (AABC) guarantee in writing.
- B. Extended warranty.
 - 1. Include an extended warranty of 2 years after completion of test and balance work, during which time the Architect/Engineer may request a retest or resetting of any outlet or other items as listed in the test report.
 - 2. Provide technicians and instruments to assist the Architect/Engineer in making any tests he may require during this period.
 - 3. The balancing agency shall perform an inspection of the HVAC system during the opposite season from that which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 TAB TOLERANCES

- A. The water, outside air, supply air, return air, and exhaust air for each system shall be adjusted to within +/- 10% of the value scheduled on the drawings.

3.2 SITE VISITS

- A. During construction, the balancing agency shall inspect the installation of the piping systems, sheetmetal work, temperature controls, energy management system, and other component parts of the heating, ventilating, and air conditioning systems. One inspection shall take place when 60% of the ductwork is installed and another inspection shall take place when 90% of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the architect and engineer.
- B. Upon completion of the installation and start-up of the mechanical equipment by the mechanical contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space of the building. If construction deficiencies are encountered that preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the mechanical contractor within a reasonable period of time, the balancing agency shall cease testing and balancing services and advise the architect, engineer, general contractor and owner, in writing, of the deficiencies.
- C. Note proper piping installation, location of valves, and flow measuring instruments.
- D. Make one series of visits, phased as required by construction progress, prior to installation of the ceiling. Note proper installation of balancing dampers.
- E. Continue the site visits up to completion of project. In each succeeding report, list corrections made from previous reports.

3.3 TESTING INSTRUMENTS

- A. Submit a list of all instruments to be used for the test and balance procedures.
 - 1. Catalog sheets
 - 2. Certificate of last calibration
 - 3. Calibration within a period of six months prior to balancing
- B. Testing equipment shall be in good working order and tested for accuracy prior to start of work.

3.4 COORDINATION WITH OTHER SPECIFICATION SECTIONS

- A. Review the related ductwork shop drawings and piping shop drawings. Make recommendations concerning suitability with respect to the testing, balancing, and adjusting work.
- B. Make tests to verify proper placement of the static pressure sensors for the variable air volume fan system control.
- C. In cooperation with the work specified in Building Management and Control System section, a systematic listing of the testing and verification shall be included in the final TAB report. The TAB firm shall provide a laptop computer to operate with the Building Management and Control System. Building Management and Control System shall provide all necessary software and special interface cables, as required, to communicate with the DDC system:

1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of the intended control performance.
 2. Verify that all control devices are properly connected.
 3. Verify that all dampers, valves, and other controlled devices, are operated by the intended controller.
 4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
 5. Verify the integrity of valves and dampers in terms of tightness of close-off and fully open positions. This includes dampers in multizone units, terminal boxes, and fire/smoke dampers.
 6. Observe that all valves are properly installed in piping system in relation to direction of flow and location.
 7. Observe the calibration of all controllers.
 8. Verify the proper application of all normally opened and normally closed valves.
 9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
 10. Observe the location of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control contractor will relocate as deemed necessary by the Engineer.
 11. Verify that the sequence of operation for any control mode is in accordance with the approved shop drawings and specifications. Verify that no simultaneous heating and cooling occurs.
 12. Verify the correct operation of all interlock systems and installation is per the manufacturer recommendations.
 13. Check all dampers for free operation.
 14. Verify that all controller setpoints meet the design intent.
 15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.
- D. Upon completion of the testing and balancing, submit three days prior notice that the systems are ready for a running test. A qualified representative of the test and balance organization shall be present, with a representative from the engineer's office to field verify TAB report readings. Specific and random selections of data recorded in the certified test and balance report will be reviewed.

3.5 INSTRUMENT TEST HOLES

- A. When it is required to make holes in the field to measure temperature, static pressure, or velocity in the ducts:
1. Drill holes, plug and tape external duct insulation.
 2. Repair damaged insulation to Engineer's approval.

3.6 TESTING THE AIR DISTRIBUTION SYSTEM

- A. The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set full open. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
1. Supply Fans:

- a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main supply and return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Outside Air: Test and adjust the outside air on applicable equipment using a Pitot-Tube traverse. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. If a traverse is not practical, use the mixed air temperature method, if the inside and outside temperature difference is at least 20°F, or use the difference between Pitot-tube traverse of the supply and return ducts.
 - e. Static Pressure: Test and record system static pressure, including the static pressure profile of each supply fan.
 2. All Other Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Static Pressure: Test and record system static pressure, including the static pressure profile of each return fan.
 3. Diffusers, Registers and Grilles:
 - a. Tolerances: Test, adjust, and balance each diffuser, grille, and register to within 5% of design requirements. Minimize drafts. Observe throws are in direction as indicated on drawings.
 4. Coils (including electric coils):
 - a. Air Temperature: Once air flows are set to acceptable limits, take wet bulb (cooling coil only) and dry bulb air temperatures on the entering and leaving side of each coil. Calculate the sensible and latent (cooling coil only) capacity of the coil. Provide information in TAB report.
- B. Record preliminary air handler data, including fan RPM and static pressures across filter, fans, and coils.

- C. Perform a velocity traverse of the main supply ducts using a pitot-tube and inclined manometer to establish initial air delivery. Perform a Pitot-tube traverse of main supply and return ducts, as applicable, to obtain total CFM. If a pitot-tube traverse is not practical, a detailed explanation of why a traverse was not made must appear on the appropriate data sheet.
- D. Where air measuring stations are installed, use pitot tube traverse readings to verify and record the correct calibration of the stations output.
- E. Make adjustments in fan RPM and damper settings, as required, to obtain design supply air, return air, and outside air.
- F. Measure and adjust all supply and return branches to design air delivery.
- G. Measure and adjust all diffusers to design air delivery to +/- 5% of design requirements.
- H. Make a set of recordings showing final system conditions.

3.7 TESTING THE HYDRONIC SYSTEMS

- A. The TAB agency shall, as applicable, verify that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; that water has been flushed and is in a clean condition, and that all balancing valves (except bypass valves) are set full open. As applicable, check air vents and expansion or compression tank for proper operation. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
 - 1. Record preliminary pump data.
 - a. Pump RPM.
 - b. Pump shut-off differential head.
 - c. Pump operating differential head.
 - d. Check and verify pump alignment.
 - e. Verify impeller diameter.
- B. Adjust balancing valves in the pump discharge lines to obtain design water quantity as read from the manufacturer's pump curve and from a flow meter.
- C. In variable flow systems, the water flow of the pump shall be set at the scheduled gpm, not the total of all the valves. Determine the diversity of the system and balance the individual coils with the maximum pump water quantity flowing in the system.
- D. Balance flow through:
 - 1. Chillers.
 - 2. Coils.
 - 3. Boiler.
 - 4. Pumps
 - 5. Condensers.
 - 6. Cooling tower.
 - 7. Heat Exchanger.

- E. Use flow meters, differential pressures, and temperature relationships as required.
- F. Balance by-pass lines to obtain the same pressure drop with systems on by-pass as full flow through the coil including the valve.
- G. Repeat steps, as required, to obtain a final systems balance and make a set of recordings showing final systems conditions.
- H. Pumps:
 - 1. Test and adjust pumps to meet design water flow requirements. Check pumps for proper operation. Pumps shall be free of vibration and cavitation. Record appropriate gauge readings for final TDH and Block-Off\Dead head calculations. Check and verify pump alignment.
 - 2. Current and Voltage: Test and record motor voltage and amperage and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.
- I. Coils:
 - 1. Tolerances: Test, adjust, and balance all chilled water and hot water coils within 5% of design flow requirements.
 - 2. Verification: Verify the type, location, final pressure drop and water quantity (GPM) of each coil. Calculate the actual capacity of all coils. This information shall be recorded on coil data sheets.
- J. Boilers:
 - 1. Verify that boilers have been filled and started by others and are in operation.
 - 2. Current and Voltage: As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
 - 3. Test, adjust and record water flows through water boilers.
 - 4. Test and record water temperature profiles of each boiler.
- K. Cooling towers:
 - 1. Verify that cooling towers have been filled and started by others and are in operation.
 - 2. Current and Voltage: Test and record motor voltage and amperage and compare data with the nameplate limits to ensure cooling tower fan motor is not in or above the service factor.
 - 3. Test and adjust water flows to balance tower cells and flows between towers.
 - 4. Test and record water temperature profiles of each condenser at design water flow for water and air side operation.
- L. Heat exchangers:
 - 1. Verify that heat exchangers have been filled and started by others and are in operation.
 - 2. Test and record temperature and pressure profiles of water and steam heat exchangers.

3.8 EQUIPMENT POWER READINGS

- A. Record the following information for each motor:
 - 1. Equipment designation.
 - 2. Manufacturer.
 - 3. Unit model number and serial number and frame.
 - 4. Motor nameplate horsepower; nameplate voltage; phase and full load amperes.
 - 5. Heater coil in starter.
 - a. Rating in amperes.
 - b. Manufacturer's recommendation.
 - 6. Motor RPM/driven equipment RPM.
 - 7. Power reading (voltage, amperes of all legs at motor terminals).

3.9 BOILERS

- A. Check for proper operation and with operation at near design conditions, record the following:
 - 1. Manufacturer, model number, serial number, and nameplate.
 - 2. If water type, water flow in GPM, entering and leaving water temperature and water pressure drop in feet.
 - 3. Type of fuel and heating value.
 - 4. Rate of fuel consumption.
 - 5. Capacity in MBH.
 - 6. Efficiency.
 - 7. Flue gas analysis.
 - 8. Motor data.
- B. Observe demonstration that all controls and safety devices are functioning properly. Record observations.

3.10 DUCT TEST

- A. Test and Balancing Contractor shall verify and record the duct test results. A copy of the duct test results, as completed, shall be submitted to the engineer for review within five days. Provide a complete report of all the duct test results in the final TAB report.

3.11 DIRECT EXPANSION EQUIPMENT

- A. With each unit operating at near design conditions, measure and record the following:
 - 1. Manufacturer, model number, serial number, and all nameplate data.
 - 2. Ambient temperature, condenser discharge temperature.
 - 3. Amperage and voltage for each phase.
 - 4. Leaving and entering air temperatures.
 - 5. Suction and discharge pressures and temperatures.
 - 6. Tons of cooling.
 - 7. Verification that moisture indicator shows dry refrigerant.

3.12 COOLING TOWERS

- A. A complete CTI certified test of the cooling tower will be performed by others at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB Report. Balance the flow over and through bypass connections of the tower.

3.13 TAB REPORT

- A. The activities described in this specification shall be recorded in a report form; and four individually bound copies shall be provided to the Architect and Engineer. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of the test instruments used and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy any incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. Provide a "Preface" which shall include a general discussion of the system and any abnormalities or problems encountered.
- B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been recorded on site by the permanently employed technicians or engineers of the TAB firm.
- C. Submit reports on forms approved by the engineer that will include the following data as a minimum:
 - 1. Title Page
 - a. Company Name
 - b. Company Address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Manager
 - g. Project Engineer
 - h. Project Contractor
 - I. Project Identification Number
 - 2. Summary of the TAB report data
 - 3. Index
 - 4. Instrument List
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Range
 - f. Calibration Date
 - g. What test instrument is to be used for:
 - 5. Fan Data
 - a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual

- e. Total static pressure (total external) specified and actual
 - f. Inlet pressure
 - g. Discharge pressure
 - h. Fan RPM
- 6. Return Air/Outside Air Data
 - a. Identification/location
 - b. Design return air flow
 - c. Actual return air flow
 - d. Design outside air flow
 - e. Actual outside air flow
 - f. Return air temperature
 - g. Outside air temperature
 - h. Required mixed air temperature
 - I. Actual mixed air temperature
- 7. Electric Motors
 - a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage, nameplate, actual
 - d. PM
 - e. Service Factor
 - f. Starter size, heater elements, rating
- 8. V-Belt Drive
 - a. Identification/location
 - b. Required driven RPM
 - c. Drive sheave, diameter, and RPM
 - d. Belt, size, and quantity
 - e. Motor sheave, diameter, and RPM
 - f. Center-to-center distance, maximum, minimum, and actual
- 9. Duct Traverse
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - I. Air correction factor
- 10. Air Monitoring Station Data
 - a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Test velocity
 - h. Test air flow
- 11. Air Distribution Test Sheet
 - a. Air terminal number
 - b. Room number/location

- c. Terminal type
- d. Terminal size
- e. Correction factor
- f. Design velocity
- g. Design air flow
- h. Test (final) velocity
- i. Test (final) air flow
- 12. Pump Data
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP
 - g. Actual flow rate, pressure drop, BHP
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
 - m. Pressure differential settings
- 13. Cooling Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Entering air WB temperature, design and actual
 - g. Leaving air DB temperature, design and actual
 - h. Leaving air WB temperature, design and actual
 - i. Water pressure flow, design and actual
 - j. Water pressure drop, design and actual
 - k. Entering water temperature, design and actual
 - l. Leaving water temperature, design and actual
 - m. Air pressure drop, design and actual
 - n. Capacity - sensible and latent
- 14. Heating Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Leaving air DB temperature, design and actual
 - g. Water pressure flow, design and actual
 - h. Water pressure drop, design and actual
 - i. Entering water temperature, design and actual
 - j. Leaving water temperature, design and actual
 - k. Air pressure drop, design and actual
 - l. Capacity
- 15. Electric Coil Data

- a. Identification/number
- b. Location
- c. Service
- d. Manufacturer
- e. Entering air DB temperature, design and actual
- f. Leaving air DB temperature, design and actual
- g. Electrical Characteristics
- h. Capacity
- 16. Sound Level Report
 - a. Location (Location established by the design engineer)
 - b. N C curve for eight (8) bands-equipment off
 - c. N C curve for eight (8) bands-equipment on
- 17. Vibration Test on equipment having 10 HP motors or greater in size.
 - a. Location of points:
 - 1) Fan bearing, drive end
 - 2) Fan bearing, opposite end
 - 3) Motor bearing, center (if applicable)
 - 4) Motor bearing, drive end
 - 5) Motor bearing, opposite end
 - 6) Casing (bottom or top)
 - 7) Casing (side)
 - 8) Duct after flexible connection (discharge)
 - 9) Duct after flexible connection (suction)
 - b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
 - c. Normally acceptable readings, velocity, and acceleration
 - d. Unusual conditions at time of test
 - e. Vibration source (if non-complying)
- 18. Control verification indicating date performed and any abnormalities identified.
 - a. Point Location/Description
 - b. EMS Readout (Setpoint and Actual)
 - c. Actual Readout of all points
 - d. Interlocks
 - e. Safeties
 - f. Variable speed drive tracking with EMS input
 - g. Variable speed drive Bypass operation
 - h. Sequence of operation

END OF SECTION

SECTION 230713 - EXTERNAL DUCT INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install external insulation on supply, return, exhaust, and outside air ductwork.
- B. External insulation of concealed and exposed ducts is included in this Section. Internal acoustic duct lining is specified under ductwork and not included in this Section.

1.2 RELATED WORK

- A. Division 9 - FINISHES. Painting and Color Coding.
- B. Division 23 - MECHANICAL.
 - 1. Air Handling Units. Internal insulation for air units is specified in the sections on air handling units. The units do not require external insulation.
 - 2. Internal Duct Liner. Internal duct liner is specified in the section on ductwork.
 - 3. Insulation. Refer to specific sections on individual insulation types.
 - 4. Refer to insulation and liner plan detail.

1.3 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship, resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
- C. All duct insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated system is not approved.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the

condensation.

- F. Where existing insulated ductwork or other services are tapped, remove existing insulation back to undamaged sections and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.4 APPROVALS

- A. Submittals. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location, and the manufacturer's installation instructions for each product.
- B. Sample Application. Make an application of each type of insulation to display the material, quality, and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Glass fiber rigid duct insulation.
 - 1. Minimum density of 3 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.7 mil aluminum foil reinforced with glass yarn mesh and laminated to 40 lbs. fire-resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 - 2. Acceptable Manufacturers
 - a. Schuller 814 spin-glas FSK.
 - b. Owens-Corning Type 703 board RKF.
 - c. Knauf 3 PCF FSK.
- B. Glass fiber blanket duct insulation.
 - 1. Minimum density of 1.0 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs. fire resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 - 2. Acceptable Manufacturers
 - a. Manville R-series Microlite FSKL.
 - b. Owens-Corning ED100 RKF.
 - c. Knauf 1.0 PCF FSK.
- D. Mastics, sealants, coatings and adhesives.
 - 1. Acceptable Manufacturers
 - a. Childers.
 - B. Foster.

c. Vimasco.

E. Fireboard Insulation

1. Totally encapsulated with foil facing.
2. Two hour rated fire protection.
3. Zero clearance to combustible protection.
4. System shall be listed and labeled by an NRTL.
5. Tested per ISO 6944, Type A Duct and achieve a 2-hour rating for stability, integrity and insulation.
6. Provided system is subject to the approval of the Local Authority Having Jurisdiction.
7. Acceptable Manufacturers
 - a. Unifrax ON Fyrewrap Elite 1.5
 - b. Partak Insulation, Inc. Paroc Fireboard
 - c. Thermal Ceramics FireMaster 3M
 - d. Premier Refractories International, Pyroscat.

F. Rigid Closed Cell Insulation

1. Acceptable Manufacturers
 - a. Dow Trymer.
 - b. Phenolic Foam.

G. Reinforced Foil Tape

1. Acceptable Manufacturers
 - a. Venture 1525CW
 - b. 3" FSK
2. Thickness 6.5 mils
3. Color: silver

2.2 COATING AND ADHESIVE

- A. Coating. Provide Childers CP-38 or Foster 30-80 vapor barrier coating. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. Outdoors: Provide as insulation coating Childers Encacel X or Foster Monolar 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249.
- C. Adhesive. Provide Childers CP-82 or Foster 85-20 vapor barrier adhesive.
- D. Reinforcing Mesh. Provide 10 x 10 white glass or polyester reinforcing mesh.

PART 3 - EXECUTION

3.1 FIRE SAFETY REQUIREMENTS

- A. Do not extend duct coverings through walls or floors required to be fire-stopped or required to have a fire resistance rating. Interrupt duct coverings in the immediate vicinity

of heat sources such as electric resistance or fuel-burning heater.

3.2 CONCEALED DUCT

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing.
- B. Standing Seams. Insulate standing seams and stiffeners, which protrude through the insulation with 0.6 lb. per cubic foot density, 1-1/2" thick, faced, flexible blanket insulation. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on twelve-inch centers to prevent sagging of insulation.
- D. On circumferential joint, the 2" flange on the facing shall be stapled with 9/16" outward clinch steel staples on 2" centers and taped using 3" wide foil tape applied with additional adhesive of Foster 85-75. Cover all seams, joints, pin penetrations and other breaks with foil tape and glue.
- E. Ductwork in mechanical rooms is considered concealed spaces.

3.3 EXPOSED DUCT INSULATION

- A. Ductwork in exposed locations is to be insulated with fiberglass rigid / semi-rigid board insulation.
 - 1. Apply fabric and mastic to provide a smooth surface for painting.
- B. Standing Seams: Insulate standing seams and stiffeners which protrude through the insulation with 0.6 lb per cubic foot density, 1-1/2 inch thick, faced insulation. As a vapor seal, use reinforcing mesh with vapor barrier coating. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork. Adhere insulation to ductwork with adhesive. In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on 12-inch centers to prevent sagging of insulation.
- D. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.

3.5 KITCHEN GREASE EXHAUST DUCTWORK

- A. Secure fireboard insulation to duct with impaling pins and 3" square speed clips. In addition, provide a wire mesh support system and additional sealing or support as required by the code enforcing authority. The insulation support system shall include

framed access to allow the insulation to be removed and replaced without damage at the access doors in the duct system for inspection and cleaning. Coordinate location of access openings to correspond accurately. Provide stainless steel banding on 12” centers.

3.6 GENERAL INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Apply insulation on clean, dry surfaces only.
- C. Continue insulation with vapor barrier through penetrations.
- D. Neatly finish insulation at supports, protrusions, and interruptions.
- E. Install insulation on clean, dry surfaces, and only after building is weatherproofed sufficiently to preclude any rainwater on insulation.
- F. Apply mastic over the fiberglass reinforcing mesh to a thickness where fabric is not visible after completion.
- G. Install fiberglass blanket duct insulation on top of supply air grilles not fire rated.

END OF SECTION

SECTION 230716 - VESSEL INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install insulation for both high and low temperature vessels.
- B. Low temperature installations include expansion tanks, air eliminators, chiller nozzles, chiller heads and other vessels containing liquids 60°F and below.
- C. High temperature installations include expansion tanks, air eliminators, domestic water storage tanks, boiler stack / transition and other vessels containing liquids above 60°F.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.
- C. All vessel insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated vessel system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation, also repair any damage caused by the condensation.
- F. Where existing insulated vessel, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 APPROVALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.
- B. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

- A. Division 9 Finishes. Painting and color-coding

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe & tank insulation:
 - 1. Schuller Type 817
 - 2. Owens-Corning Type 705
 - 3. Knauf 2.8 PCF
- B. Aluminum Jacketing:
 - 1. Childers
 - 2. Pabco
 - 3. RPR
- C. Monel Staples
 - 1. Bostich Monel
 - 2. Duo-Fast Monel
 - 3. Markwell Monel
- D. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Foster Mast a Fab

2.2 CEMENT, MASTICS, SEALANTS, ADHESIVES AND COATINGS

- A. Adhesive: Provide Childers CP-127 or Foster 85-60 fiberglass adhesive to seal insulation for low temperature vessels.
- B. Lagging Adhesive / Coating: Furnish Childers CP50AHV2 or Foster 30-36 lagging adhesive / coating to provide a finish coat and to secure finish cloth for high temperature vessels.

- C. Insulation Joint Sealant: Use Childers CP-76 or Foster 95-50 to seal the joints of insulation on low temperature vessels.
- D. Metal Jacketing Sealant: Use Childers CP-76 or Foster 95-44 on all metal jacketing laps outdoors.
- E. Vapor Barrier Coating: Indoors - Use Childers CP-38 or Foster 30-80 vapor barrier coating finish to coat the canvas finish on low temperature vessels. Permeance shall be 0.013 perms or less as tested by ASTM E96. Coating must comply with MIL-C-19565C, Type II and be QPL listed. Permeance shall be 0.03 perms or less at 30 mils, dry. Tested at 100°F and 90% RH per ASTM F 1249 and by Hypalon rubber based.
- F. Weather Barrier Mastic: Furnish Childers CP-10/11 or Foster 46-50 weather barrier mastic and reinforcing mesh for outdoor finish.
- G. Reinforcing Mesh: Furnish 10 X 10 white glass or polyester reinforcing mesh.

PART 3 - EXECUTION

3.1 LOW AND HIGH TEMPERATURE VESSELS (FIBERGLASS)

- A. Apply a first layer of insulating board. Band the board on immediately after application, using bands on 12" centers, drawn tight and securely fastened.
- B. Apply successive layers of insulation as specified for the first layer, with joints staggered. After insulation has been applied, finish with Childers CP-38 or Foster 30-80 vapor barrier coating reinforced with glass or polyester reinforcing mesh per manufacturer's recommendations. Provide a flood coat of Childers CP-10/11 or Foster 46-50 with Foster Mast a Fab polyester or Chil Glas #10 reinforcing mesh.
- C. To insulate removable heads, provide two equal sections of heavy-gauge, galvanized sheet metal covers, angle reinforced and lined with insulation board. Make covers easily removable to allow free access to the heads for inspection, cleaning, and dismantling. Provide suitable flanges on the sections with neoprene gaskets between them, permitting a tight seal when the two sections are bolted together. Fill the voids with glass fiber wall cavity insulation.

3.2 ALUMINUM JACKETING (Insulated vessels outdoors above grade)

- A. Apply aluminum jacket on vessels according to manufacturer's recommendations using aluminum strapping and metal jacketing sealant to provide weather tight covering.
- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function.
- C. Install straps on 12" centers.

3.3 VESSEL INSULATION REQUIREMENTS

- A. Insulate all low and high temperature vessels located exterior (outside) of the building, including the following:
 - 1. Air separators
 - 2. Expansion Tanks
 - 3. Chemical feeders
 - 4. Chilled water system volume tanks
 - 5. Insulation thickness shall match thickness of adjoining pipe insulation
- B. Insulate all low temperature vessels located interior (inside of the building, including the following:
 - 1. Air separators
 - 2. Chemical feeders
 - 3. Chilled water system volume tanks
 - 4. Insulation thickness shall match thickness of adjoining pipe insulation
- C. Insulate the following high temperature vessels located interior (inside the building).
 - 1. Air Separators
 - 2. Insulation thickness shall match thickness of adjoining pipe insulation
- D. As indicated on the drawings

END OF SECTION

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including, heating water, condenser water, refrigerant lines, condensate piping and make-up water.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 SUBMITTALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for

each service and location and the manufacturer's installation instructions for each product.

- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

- A. Finishes. Painting and color-coding
- B. Pipe Heat Tracing

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe insulation:
 - 1. Johns-Manville Micro-Lok AP-T
 - 2. Owens-Corning ASJ/SSL
 - 3. Knauf ASJ/SSL
- B. Cellular Glass Insulation (Foamglass):
 - 1. Pittsburg Corning
 - 2. Cell-U-Foam
- C. Rigid Foam Insulation:
 - 1. Kingsapan Tarec
 - 2. Dow Trymer
 - 3. Tarec Ecophen – Phenolic Foam
- D. Aluminum Jacketing:
 - 1. ITW Lock-on (Childers)
 - 2. ITW Z-lock (Pabco)
- E. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Foster Mast a Fab
 - 5. Vimasco
- F. Mastics, Sealants, Coatings and Adhesives
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
 - 4. Armacell 520 Adhesive
- G. Elastomeric Insulation
 - 1. Armacell

- H. Weather Resistant Coating
 - 1. WB Armaflex Finish
 - 2. Foster 30-64
- I. Glass fiber blanket insulation
 - 1. Manville R-series Microlite FSKL
 - 2. Owens-Corning eD75 or ED100 RKF
 - 3. Knauf 0.75 PCF FSK

2.2 RIGID FOAM PIPE INSULATION

- A. Polyisocyanurate pipe insulation or phenolic foam pipe insulation, with all service reinforced vapor barrier jacket having integral laminated vapor barrier.
 - 1. Polyisocyanurate: Thermal conductivity 0.14 @ 75°F mean (ASTM C518).
 - 2. Phenolic Foam: Thermal conductivity 0.13 @ 75°F mean (ASTM C 518); minimum 2.5# density.
 - 3. Polyisocyanurate is not to be used inside of buildings without 25/50 rating.

2.3 FIBERGLASS PIPE INSULATION

- A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
 - 1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.4 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than 3/4" shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test.
 - 1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.5 CELLULAR GLASS INSULATION

- A. ASTM C552:
 - 1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
 - 2. 8.0 lb/cu.ft. (128 kg/cu.m.) density

2.6 INSULATION/SHIELD AT HANGERS

- A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and

conforming to the schedule. Insulation shall extend at least 1” beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½” aluminum bands (2) per shield.

1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
 2. Minimum thickness of foam glass insulation shall not be less than 1” thick.
- B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22”. Provide 18 gauge through 4” pipe and 16-gauge 5” pipe and above.

2.7 SEALANT, ADHESIVE AND FINISH

- A. Lap Adhesive. Provide Childers CP-82 or Foster 85-20 adhesive.
- B. Vapor Barrier Finish:
1. Indoors: Provide as insulation coating Childers CP-38 or Foster 30-80, white. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
 2. Outdoors: Provide as insulation coating Childers Encacel X or Foster 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249 and must be Hypalon rubber based.
 3. Underground: Provide Childers CP-22/24 or Foster 60-25/26 for fittings and areas. Pittwrap cannot be used.
- C. Insulation Joint Sealant. Provide Childers CP-76 or Foster 95-50 vapor barrier sealant.
- D. Metal Jacketing Sealant. Provide Childers CP-76 or Foster 95-44 metal jacketing sealant for all outdoor metal jacketing laps.
- E. Lagging Adhesive. Provide Childers CP-50AMV1 or Foster 30-36.
- F. Other products of equal quality will be acceptable only upon approval.

2.8 ALUMINUM JACKETING

- A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016” thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier.
- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024” thick.
- C. Straps and Seals. Provide ½” x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.9 GLASS FIBER BLANKET INSULATION

- A. Minimum density of 1.0 PCF, 2” thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

2.10 FIRE BARRIER PLENUM WRAP

- A. High temperature insulation blanket specifically designed to provide a single layer, flexible enclosure around combustible items located within fire rated return air plenums.
- B. Use of this method is subject to approval of the Local Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 INTERIOR PIPING

- A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3” wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-38 or Foster 30-80 vapor barrier coating for chilled water piping applications.
- B. Install hanger with protective shield, on the outside of all insulation.
- C. Where domestic water pipes (1/2” & 3/4” pipe sizes) are installed on trapeze type hangers, provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.
- D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4” pipe and 16-gauge for 5” pipe and above.
- E. Seal ends of pipe for chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.
- F. Apply a smooth flood coat of white lagging adhesive Foster 30-35 or Childers CP-35 over all exposed insulation within mechanical rooms.
- G. Piping to be insulated as specified above:
 - 1. Chilled water and heating water
 - 2. Make-up water
 - 3. Horizontal sanitary drain piping that receives condensate
 - 4. Condenser water

3.2 REFRIGERANT AND CONDENSATE PIPING

- A. Cover all pipe with elastomeric insulation by slitting tubular sections or sliding unslit sections over the open ends of piping or tubing. Seams and butt joints shall be adhered and sealed using Foster 85-75, Childers CP-82 or Armstrong 520 Adhesive.
- B. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Foster 85-75, Childers CP-82 or 520 Adhesive.
- C. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter.
- D. Outdoor exposed piping shall be painted with two coats of either WB or SB Armaflex finish or Foster 30-64 elastomer foam coating. All seams shall be located on the lower half of the pipe.
- E. Outdoor exposed piping after being sealed as noted above apply aluminum jacketing to protect piping insulation exposed to weather, from damage from sunlight, moisture, equipment maintenance, wind, and shall provide shielding from solar radiation. Adhesive Tape shall not be permitted.

3.3 PIPING OUTDOORS ABOVE GRADE

- A. Insulate all water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.
- B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
- C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using Childers CP-82 or Foster 85-20 adhesive. Secure fitting insulation covers and segments in place with ½" wide glass filament tape.
- D. Apply a tack coat of fitting vapor barrier coating over the insulation and tape.
- E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
- F. Apply coating over the fiberglass cloth to a thickness where the mesh is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier coating at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- H. Finish with aluminum jacketing as specified.

3.4 UNDERGROUND PIPE COVERING

- A. Cover chilled and hot water piping underground with cellular glass insulation.
- B. Butter insulation joints with Childers CP-76 or Foster 95-50 vapor barrier sealant. Secure with stainless steel bands or ½” fiberglass reinforced tape on 9” centers.
- C. Cover valves and flanges with fabricated fittings of thickness and material equal to the adjoining insulation. Fasten fittings in place with stainless steel bands or ½” fiberglass reinforced tape.
- D. Apply a tack coat of fitting mastic Childers CP-22/24 or Foster 60-25/26 over the insulation and bands.
- E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
- F. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier mastic at all valves, fittings, flanges and every 21' on straight run piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe, making a complete seal.
- H. Finish with 125 mil thickness Pittwrap jacket applied in accordance with manufacturer's instructions. At contractor's option, cover insulation with Servi-Wrap P-500 installed in accordance with manufacturer's instructions.

3.5 FLANGE, VALVE AND FITTING INSULATION

- A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
 - 1. Apply a tack coat of insulating coating/mastic to the insulated fitting to produce a smooth surface.
 - 2. After mastic is dry, apply a second coat of vapor barrier coating/mastic. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
 - 3. Overlap coating/mastic and fiberglass/polyester reinforcing mesh by 2” on adjoining sections of pipe insulation.
 - 4. Apply a second coat of coating/mastic over the fiberglass/polyester reinforcing mesh to present a smooth surface.
 - 5. Apply coating/mastic to a wet film thickness of 3/64”.
 - 6. Fabric shall not be visible after completion.
 - 7. Vapor seal flanges, valves and fittings with Childers CP-38 or Foster 30-80. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. PVC fitting covers are not acceptable.

3.6 ALUMINUM JACKETING (Insulated Piping Outdoors Above Grade)

- A. Apply smooth aluminum jacket on piping, valves, fittings and flange covers according to manufacturer's recommendations, using stainless steel strapping and seals, to provide weather tight covering and to shed water.
- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function. Lap each adjoining jacket section a minimum of 3" to make a weather tight seal with the application of 1/8" bead of Childers CP-76 or Foster 95-44 metal jacketing sealant.
- C. Install straps on 9" centers and at each circumferential lap joint.
- D. Cover and seal all exposed surfaces.
- E. The use of screws and rivets is not approved.
- F. Provide isolation (30# felt) between the aluminum jacket and the sheetmetal protection shield at each pipe support point.

3.7 MISCELLANEOUS

- A. Insulate pumps.
- B. Install materials after piping has been tested and approved.
- C. Apply insulation on clean, dry surfaces only.
- D. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.8 INSULATION THICKNESS

<u>INSULATED UNIT</u>	<u>THICKNESS (Inches)</u>
Refrigerant Piping	1-1/2
Chilled Water Piping (through 2" pipe)	1-1/2
Chilled Water Piping (2-1/2" pipe and Larger)	2
Condensate Drains	1
Exterior Condenser Water Piping	2
Heating Water Piping 2" Pipe and Larger	2
Heating Water Piping 1-1/2" Pipe and Smaller	1-1/2
Exterior Chilled and Hot Water Piping, 5" Pipe and Larger	2
Exterior Chilled and Hot Water Piping 4" Pipe and Smaller	1-1/2
Underground Piping Covering, 1-1/2" Pipe and Smaller	1
Underground Pipe Covering 2" Pipe and Larger	1-1/2

END OF SECTION

SECTION 230933 - BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. Provide and install a complete Building Management and Control System (BMCS), including industrial instrumentation necessary to obtain functions and results specified. A complete system includes items such as sensors, valves, dampers, valve, and damper operators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. Integrate all components to provide a complete and functioning system.
- B. Temperature Control System components:
 - 1. Electronic instruments as specified
 - 2. Electric instruments as specified
 - 3. Microcomputer instruments as specified
- C. All control devices of the same type of product shall be of a single manufacturer.
- D. Control, power, and interlock wiring necessary to accomplish sequences specified in this Section shall be provided and installed by the Control Subcontractor. Materials and methods of execution as specified in Division 26, Electrical.
 - 1. Coordinate current characteristics of all electrical instruments and equipment with Division 26 of the specifications and related electrical drawings.
- E. The entire Building Management and Control System (BMCS) shall be installed by the Automation System Manufacturer or Authorized Distributor.
 - 1. All components and elements
 - 2. The testing and acceptance procedure
- F. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- G. The entire Building Management and Control System (BMCS) shall be installed, Commissioned, and tested; all performed by the Automation System Manufacturer or Authorized Distributor if approved by engineer.
 - 1. All components and elements.
 - 2. Start-up and point verification.
 - 3. The testing and acceptance procedure.

1.2 RELATED WORK

- A. Division 23, Mechanical
- B. Division 26, Electrical

1.3 SUBMITTALS

- A. Submit items of the Building Management and Control System (BMCS).
 - 1. Temperature control equipment & Field devices.
 - 2. Wiring & Flow diagrams.
 - 3. Sequence of operation.
 - 4. Complete, detailed, control and interlock-wiring diagram.
 - 5. Indicate mechanical and electrical equipment furnished and electrical interlocks, indicating terminal designation of equipment. Respective equipment manufacturers shall furnish through the Mechanical Contractor, approved drawings of equipment to be incorporated in this diagram.
 - 6. Submit Input / Output summary of all points.
 - 7. Submit an outline of testing procedures from section Testing and Acceptance.
 - 8. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: “Comply, “Do Not Comply”, or “Not Applicable”. Explain all “Do Not Comply” statements.
 - 9. Submit sample of space temperature sensor and guards for review prior to purchase or installation.

1.4 COOPERATION WITH OTHER TRADES

- A. Furnish control valves, temperature sensing element wells, flow and pressure sensing devices, dampers, and other similar devices to the Mechanical Contractor in a timely manner for installation under the Building Management and Control System (BMCS), Subcontractor's supervision.

1.5 WARRANTY

- A. Provide with a manufacturer’s parts and labor warranty for a period of two years from substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Alerton
- B. Automated Logic
- C. Siemens Building Technologies
- D. Honeywell
- E. Distech

2.2 SYSTEM ARCHITECTURE

- A. The Building Management and Control System (BMCS) shall consist of an information-sharing network of stand-alone Direct Digital Control Panels (DDCP) to monitor and control equipment as specified of the control sequence and input/output summary.

- B. "Information sharing" shall be defined as: The function of each DDCP to exchange data on the network trunk with other DDCP's without the need for additional devices such as network managers, gateways, or central computers.
- C. "Stand-alone" shall be defined as: The function of each DDCP to independently monitor and control connected equipment through its own microcomputer.

2.3 COMMUNICATIONS PROCESSING

- A. The BMCS shall operate as a true token-pass peer-to-peer communication network. Resident processors in each DDCP shall provide for full exchange of system data between other DDCPs on the network trunk. Systems that limit data exchange to a defined number of system points are not acceptable.
- B. Systems that operate via polled response or other types of protocols that rely on a central processor or similar device to manage DDCP-to-DDCP communications may be considered only if a similar device is provided as a standby. Upon a failure or malfunction of the primary device, the standby shall automatically, without any operator intervention, assume all BMCS network management activities.
- C. The failure of any DDCP on the network shall not affect the operation of other DDCPs. All DDCP failures shall be annunciated at the specified alarm printers and terminals.
- D. The network shall support a minimum communications speed of **1 Gbps**.
- E. The network shall support a minimum of **500 DDC controllers and PC workstations**.
- F. Each PC workstation shall support a minimum of **4 peer-to-peer networks**, either by hardwired connection or wireless.
- G. The system shall support integration of third-party systems (fire alarm, security, lighting, PLC, chiller, boiler) via panel-mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein for hardwired points. Provide examples of **5 reference projects** utilizing gateways required for this project.

2.4 DDCP HARDWARE

- A. Each DDCP shall consist of a **64-bit microprocessor** and controller, power supply, input/output boards, and communication board. All program and point databases shall be stored in **non-volatile memory**. Provide a minimum of **8 GB RAM** in each DDCP to allow for point expansion and trend data storage.
- B. Each DDCP shall incorporate a real-time clock.
- C. Each DDCP shall be provided with **two Ethernet ports**. Connecting an operator terminal, whether portable or stationary, shall allow the user to communicate with the entire network.
- D. Each DDCP shall provide for input/output connections to field equipment. The following point types shall be supported:
 - 1. **Analog inputs** - for measuring sensed variables. Inputs shall be capable of accepting voltage, resistance, current, or pressure signals.
 - 2. **Analog outputs** - for controlling end devices. Outputs shall be capable of producing voltage, resistance, current, or pressure signals. Pneumatic outputs shall be provided with a manual override for adjusting outputs in the event of a power loss at the DDCP.
 - 3. **Digital inputs** - for monitoring dry contacts such as relays, switches, pulses, etc.
 - 4. **Digital outputs** - to control two-position devices such as starters, actuators, relays, etc.
- E. Each DDCP shall be listed under **UL916 (Energy Management Systems)** and shall be tested to

comply with **sub-part J of Part 15 FCC rules** for Class A computing equipment.

F. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:

1. Control processes.
2. Energy management applications
3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
4. Historical/trend data for points specified.
5. Maintenance support applications
6. Custom processes
7. Operator I/O
8. Remote communications
9. Manual override monitoring

G. Operators shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, onboard hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.

1. Switches shall be mounted either within the DDC Controller's key-accessed enclosure or externally mounted with each switch keyed to prevent unauthorized overrides.
2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.

H. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.

I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of **72 hours**.

1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local Ethernet port, via remote access, or from a network workstation PC.
3. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2.5 PROGRAMMING FUNCTIONS

- A. Resident software in each DDCP shall provide custom programming of control strategies.
 1. Point database
 2. Operator interface
 3. Network communications
 4. Facilities and energy management functions
- B. Programming of control and energy management strategies shall be accomplished via a high-level computer language such as BASIC, JC BASIC, C, or Powers Process Control Language. A standard math processor shall be part of the programming language. All

analog loops shall be capable of proportional, integral, and derivative control.

- C. Each DDCP shall incorporate an operator interface program (OIP) that provides an English language user interface. The OIP shall allow the user to program, interrogate, command, and edit the BMCS via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access the entire network from any DDCP. Access shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

2.6 FACILITY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with standard and custom report generation functions that include:
 - 1. Alarm summaries
 - 2. Motor status summaries
 - 3. Point displays by type, system, status, overrides, failures, location, equipment and enabled/disabled.
 - 4. Program listings
- B. All reports shall be either displayed or printed by:
 - 1. Operator request.
 - 2. Time of day.
 - 3. Event conditions (such as in response to an alarm, interlock, etc.).
- C. All reports shall be time and date stamped.
- D. An alarm-processing program shall be provided to annunciate those points designated as alarmable. Alarm points shall, upon alarm occurrence, be displayed or printed at designated terminals.
- E. Historical trend data shall be collected and stored at each DDCP for later retrieval. Retrieval shall be manual or automatic. Any point, physical or calculated, may be designated for trending. The system shall allow for two methods of trend collection: Either by a pre-defined time interval sample or upon a pre-defined change of value. Trend data shall be presented in a columnar format. Each sample shall be timed stamped. Trend reports may be a single point or may be a group of points, up to a maximum of (8) points in any single group. Any point, regardless of physical location in the system may become part of a multiple point group.
- F. Each BMCS network shall provide a point-monitoring function that can display single or multiple points in a continuous updated fashion for dynamic displays of point values.
- G. A database and configuration report program shall be provided that allows the user to interrogate BMCS status. As a minimum, the user shall be able to: Verify available RAM at each DDCP, verify DDCP status (on-line, off-line, and failed) and set the system clock.
- H. Any invalid operator entry shall result in an error message.
- I. DDCP's shall contain a password access routine that will assign an operator to one of three level of access. Level 1 shall permit display function only, level 2 shall additionally

permit commanding of system points and level 3 shall additionally permit full program and database editing.

- J. DDCP's shall provide for the accumulation of totalized values for the purposes of run-time or energy totalization. Totalized values may be displayed or printed automatically or by operator request.

2.7 ENERGY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with an optimal start program such that the building may be divided into ten zones for optimum start. Warm-up and cool-down shall occur in sequence with succeeding zones starting only after the preceding zone has completed its warm-up or cool-down.
 - 1. The optimum start-up time of assigned equipment shall be determined based on a software calculation that takes into consideration outdoor air conditions, space conditions, and building thermal characteristics ("U" factor).
 - 2. The optimum start program shall control start-up of the cooling and heating equipment to achieve the target occupancy space temperature at the precise time of building occupancy.
 - 3. A Built-In "learning" technique shall cause the BMCS to automatically adjust itself to the most affective time to start equipment based on historical data.
- B. The BMCS shall be provided with an operator interactive time of day (TOD) program. TOD programming and modifying shall be accomplished in a calendar-like format that prompts the user in English language to specify month, year, day and time and associated point commands. It shall be possible to assign single points or groups of points to any on or off time. Appropriate time delays shall be provided to "stagger" on times.
 - 1. TOD shall incorporate a holiday and special day schedule capability, which will automatically bring up a pre-defined holiday or special day schedule of operation. Holidays or special days can be scheduled up to one year in advance.
 - 2. In addition to the time dependent two-state control, TOD also provides time dependent setpoint control. This control provides the capability to output assignable, proportional setpoint values in accordance with the time of day and day of week. This program shall be used to accomplish night setback, morning warm-up and normal daily operating setpoints of all control system loops controlled by the BMCS. As with the two-state control, time dependent setpoint control shall be subject to the holiday schedule. The setpoints desired shall be user definable at any operator terminal.
 - 3. The operator shall be capable of reading and/or altering all sorted data pertaining to time of day, day of week, on/off times, setpoint values, and holiday designation.
 - 4. The TOD program shall also provide an override function that allows the user to conveniently change a start or stop time for any point up to one week in advance. The override command shall be temporary. Once executed the TOD program shall revert to its original schedule.
 - 5. The TOD program shall interface with the optimal start program (OSP) such that stop times may be assigned by OSP.
- C. Additional Program functions required are to be installed and programmed as requested by end user at no additional cost:

1. Enthalpy optimization.
2. Supply air reset.
3. Hot water reset.
4. Chilled water reset.
5. Volumetric control.
6. Dead band control. Install dual set points as requested by user.
7. All specified energy management programs, whether or not applicable to this project shall be provided such that the owner may enable the program at a future date without the need to purchase additional software or modify existing software.

2.8 WEB SERVER ACCESSIBILITY

- A. Industry leading encryption technology to provide accessibility through a web browser.
- B. Building Manager's ability to access, view and command critical building information in real time over the intranet or internet.
 1. Alarm Display
 2. Point Commanding
 3. Graphic Display
 4. Scheduling
 5. Running Reports
 6. Point Details

2.9 REMOTE NOTIFICATION

- A. Remote notification sends Alarm and System Event information to various notification devices as indicated below but not limited to. Operators can receive their building automation system alarms without restricting them to dedicated workstations.
 1. Alphanumeric pagers
 2. Numeric pagers
 3. Email
 4. Phones via voice or short message service (SMS)

2.10 POINT EXPANSION MODULES

- A. Capable of extending its input/output capabilities via special purpose modules.
 1. Modules may be mounted remote from the DDCP.
 2. Shall communicate with the DDCP over a pair of twisted cables.

2.11 TERMINAL EQUIPMENT CONTROLLERS

- A. Provide for control of each piece of equipment, including, but not limited to, the following:
 1. Unit Conditioners
 2. Heat Pumps
 3. Fan Coil Units
 4. Water Source Heat pumps
- B. Include the following items:

1. All input and outputs necessary to perform the specified control sequences.
 - a. Analog outputs shall be industry standard signals such as 24V floating control.
2. Sufficient memory to accommodate point database, operating programs, local alarming and local trending.
3. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 100-hour battery backup shall be provided.
4. Return to full normal operation without user intervention after a power outage of unlimited duration.
5. Operation programs shall be field selectable for specific applications.
6. Specific control strategy requirements, allowing for additional system flexibility.
7. Controllers that require factory changes of all applications are not acceptable.

2.12 ELECTRONIC DAMPER ACTUATORS

- A. Two position damper operators:
 1. Spring return to full travel position.
 2. Built in auxiliary switches (motor end switches)
 - a. Switch shall be fully adjustable so that cut-in/cut-out points may be preset at any point within angular travel of the motor.
 3. Minimum torque 60-in-lb
- B. Modulating damper operators:
 1. Sized with sufficient reserve power to provide smooth modulating action and tight close off against the system pressure
 2. Select the operator with available torque to exceed the maximum required operating torque by not less than 100%
 3. Minimum torque 100 in-lb

2.13 ETHERNET CARD

- A. Ethernet Card:
 1. Local area network connection interface card.

2.14 CONTROL CABINETS

- A. Fully enclosed NEMA 1 for indoors, NEMA 4 for outdoors.
 1. Powder coat painted on all sides
 2. Cabinet with continuously piano type hinged door
 3. Locking latch
 4. All locks shall use a common key
 5. Devices on the panel face must be identified with engraved nameplates.
 6. Panels or termination panels must be identified with engraved nameplates.
 7. Provide enamel beige finish and extruded aluminum alloy frame UL 50 certified.

2.16 AUTOMATIC CONTROL VALVES

- A. Pressure ratings: Minimum 125 psig or 1.25 times maximum system operating pressure.

- B. Construction:
 - 1. 2" and smaller:
 - a. Screwed.
 - b. Bodies and internal parts: Bronze, stainless steel, or other approved corrosion-resistant metal.
 - 2. 2-1/2" and larger:
 - a. Flanged.
 - b. Bodies: Cast iron or cast steel.
 - c. Seats and parts exposed to fluid: Bronze, stainless steel, or other approved corrosion-resistant metal.
 - 3. Characterized port ball valves are acceptable for VAV terminal units only.
- C. Modulating straight through water valves: Equal percentage contoured throttling plugs.
- D. Three Way Mixing Valves: Linear throttling plugs allowing total flow through valve to remain constant regardless of position.
- E. Sizes: By Automatic Control System Manufacturer for fully modulating operation.
 - 1. Minimum pressure drop: Equal to pressure drop of coil or exchanger.
 - 2. Maximum pressure drop: 5.5 psi.
 - 3. Relief and bypass valves: Sized according to pressure available.
 - 4. 2-position valves: Line size.
 - 5. Manual by-pass operator.
- F. Electronic Actuator:
 - 1. Direct coupled installation
 - 2. Visual and electronic stroke indicator
 - 3. Die-cast aluminum housing
 - 4. Manual override
 - 5. Self-lubricating bearing and gear train
 - 6. Automatic calibration
 - 7. Automatic duty cycle protection
 - 8. Overload and stall protection
 - 9. Non-spring return
 - 10. Floating /0-10 VAC / 4-20mA operation
 - 11. UL approved
 - 12. Provide smooth modulating action and tight close off against the system pressure.
 - 13. Torque to exceed the maximum required operating torque by not less than 150%.
 - 14. Actuator input signal shall be compatible with output DDC controller.
 - 15. Provide weatherproof enclosure (exterior use).
 - 16. Damper actuators not acceptable for valves.
- G. Cooling Tower By-Pass / Cooling Tower Isolation Valves & Actuators:
 - 1. Valve Bray (Series 3L)
 - a. Line Size Valve
 - b. Under-cut disk for smooth operation
 - c. Full Lug Valve
 - d. Cast Iron Body
 - e. EPDM – Molded-in Seat
 - f. 416 Stainless Steel Stem

- g. Nylon Coated Ductile Iron Disc
 - h. Disc-to-stem connection shall utilize a double “D” or key design requiring no screws or pins to connect stem to disc.
 - 2. Electronic Actuator: Bray (Series 70)
 - a. Fully configurable without need for software or handheld settings device
 - b. Direct Mount
 - c. Solid state speed control
 - d. Visual and electronic stroke indicator.
 - e. Anti-Condensation Heater (exterior actuators)
 - f. Die-cast aluminum housing.
 - g. Manual override by means of hand wheel
 - h. Self-lubricating bearing and gear train.
 - i. All steel self-locking output gearing to be provided
 - j. Continuous Duty Rated Motor
 - k. Overload and stall protection.
 - l. Floating /0-10 VAC / 4-20mA operation.
 - m. Mechanical Travel stops
 - n. UL approved.
 - o. Smooth modulating action.
 - p. Tight close off against the system pressure.
 - q. Sized to exceed 150% of the maximum required operating torque of the valve while under the maximum operating shut-off pressure
 - r. Actuator input signal shall be compatible with output DDC controller.
 - s. Provide weatherproof enclosure
 - t. Damper actuators not acceptable for valves.
- H. Variable Primary Flow By-Pass Control Valve:
 - 1. Modulating straight through control valve with equal percentage contoured throttling plug and electronic operator.
 - 2. Maximum pressure drop: 10 psi
 - 3. Sized for minimum flow of one chiller
 - 4. Torque to exceed the maximum required operating torque by not less than 150%.

2.17 FLOW DETECTION SWITCHES

- A. Remote Flow Solid-State Flow Detection:
 - 1. Extended length flow probe
 - 2. Cabinet-mounted control monitor
 - 3. Wetted parts, 316 stainless steel probe
 - 4. Optional temperature and wire-break outputs
 - 5. Flow and temperature switch points
 - 6. LED bar graph display for status indication
- B. Approved Manufacturer:
 - 1. IFM Effector

2.18 DIFFERENTIAL PRESSURE SWITCHES

- A. Wet/wet differential pressure switch
 - 1. Integral Mounting Frame

2. Watertight, dust-tight, and corrosion resistant enclosure.
3. Wetted materials of brass and fluor elastomer.
4. Externally adjustable set point

B. Approved manufacturer:

1. Square D #9012GGW4
2. Dwyer #DXW-11-153-1
3. Carrier #HK06ZC033

2.19 TEMPERATURE LOW LIMIT SWITCH

A. Responsive to the coldest 1' section of its length.

1. Double pole single throw switch
2. 20' capillary
3. Line voltage with bellows actuated switch
4. Auto reset for outdoor installation
5. Manual reset for indoor installation

2.20 TEMPERATURE AND HUMIDITY SENSORS

A. Space Temperature Sensors

1. Thermister with resistance of 10,000 ohms at 77°F.
2. Accuracy shall be $\pm 1/2^\circ\text{F}$.
3. Range of 55° to 95° F.
4. Surface Mounted (edit for each project)
 - a. Digital temperature display (edit for each project)
 - c. Override button (edit for each project)
 - d. Color to be approved by Architect / Owner, submit sample for review
6. Location and height to be approved by Architect/Engineer prior to installation.
7. Provide guards impact resistant Polycarbonate equal to BAPI-Guard in all public locations.

B. Space / Duct Humidity Sensor

1. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
2. Capacitance element shall be field replaceable and not require calibration.
3. Accuracy shall be $\pm 2\%$ in the range from 20 to 95% RH.
4. Relative humidity sensors shall have the sensing element of inorganic resistance media.
5. Provide impact resistant Polycarbonate equal to BAPI-Guard covers suitable for institutional use. Submit sample for review.
6. Provide manufacturers calibration certificate.
7. Provide impact resistant Polycarbonate equal to BAPI-Guard guards in all public locations

C. Duct Temperature Sensors

1. Range of 20° to 120°F.
2. Single point sensing of temperature.
3. Averaging elements of sufficient length to sense temperature across 2/3 duct

- width.
- 4. Averaging elements of sufficient length to provide accurate, representative indication and control.
- 5. Averaging elements of sufficient length to prevent variances in temperature or stratification.
- D. Liquid Immersion Temperature Sensors
 - 1. Platinum type resistance temperature detector (RTD).
 - 2. Match sensor range to medium being monitored.
 - a. Hot water range 30° to 250°F.
 - b. Chilled Water 20° to 70°F.
 - 3. Furnish stainless steel wells for installation by Mechanical Contractor.
 - 4. Locate all sensors in field with Owner/Engineer present.
 - 5. System accuracy for liquid temperature sensing shall be $\pm 1/2^\circ$.
 - 6. Sensors must be removable from wells.
- E. Outside Air / Freezer / Cooler Sensors
 - 1. Range of -58° to 122°F .
 - 2. Weatherproof sun shield.
 - 3. External trim material corrosion resistant with all parts assembled into watertight, vibration-proof, heat resistant assembly.
 - 4. Minimum of 8' long leads.
 - 5. Encapsulated into Type 304 stainless steel tubes with low conductivity moisture proofing material and lag extension for thickness of insulation.

2.21 CURRENT SENSITIVE RELAYS

- A. Ensure compatibility with VFD applications for variable speed motor status.
 - 1. Provide with adjustable set point.
 - 2. Relays must be mounted and not hung by power wires thru CT.
 - 3. Provide split-core type current sensors.
 - 4. Loop powered.
 - 5. LED Status.
 - 6. Acceptable Manufacturer: Veris Industries / Hawkeye
 - 7. Relays shall close status contacts in response to current flow in power leads to the equipment being monitored.

2.22 DIFFERENTIAL PRESSURE TRANSDUCER

- A. Transducers to convert differential pressures to 4-20 MA analog outputs.
 - 1. Solid state pressure sensor with accuracy of $\pm 1\%$ of calibration range.
 - 2. Factory calibrated and have zero and span trimmers for field calibration.
 - 3. Range shall be selected to match the medium being monitored.
 - 4. Pressure snubbers to protect from pressure pulses and a 3-way bypass / valve assembly to protect the transducer from overpressure damage during start-up.
 - 5. LCD Display
 - 6. Acceptable Manufacturer: Rosemount 1151 or 3051 Pressure Transmitter

2.23 FLOW DIFFERENTIAL PRESSURE SWITCH

- A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system differential pressure.
 - 1. Select the pressure range based on the sensed differential pressure.
 - 2. The unit shall be protected against overpressure to the full static pressure rating.
 - 3. Accuracy: +/- 2% of full scale.
- B. Switch assembly.
 - 1. Reed switch.
 - 2. NEMA-4 enclosure.
 - 3. Threaded boss conduit entrance.
 - 4. SPST action.
 - 5. Voltage and rating as required for the control circuit.
- C. Wetted parts shall be made of type 303 stainless steel.
- D. Install an isolation valve in each sensing pipe leg to permit servicing without shutting the system down.

2.24 ELECTRIC REMOTE BULB THERMOSTAT

- A. Two position remote bulb thermostat:
 - 1. Bimetal controlled.
 - 2. Sealed mercury switches.
 - 3. Provide specified control action.
 - 4. Adjustment can be made by removing unit cover.
 - 5. Element with capillary length as required for the location.

2.25 ELECTRIC SPACE THERMOSTAT

- A. Two position space thermostat.
 - 1. Single Pole switch actuated by bi-metal sensing element.
 - 2. Range shall be 60°F to 90°F.
 - 3. Removable external knob adjustment means.

2.26 HIGH STATIC PRESSURE SWITCH

- A. With manual reset switch
 - 1. Approved manufacturer: Cleveland AFS-460.

2.27 INSERTION FLOW SENSORS

- A. Turbine Flow Meter
 - 1. Retractable hot tap flow sensor
 - 2. Accuracy: +/- 1% of full scale
 - 3. Dual Turbine
 - 4. Custom thread-o-let 400 psi / 250°F rated
 - 5. Line size from 2-1/2 to 72 inch
 - 6. Metering ranges from 0.3 to 15 f/sec.
 - 7. Remote NEMA 4 wall mounted LCD display

8. Field Pro Software & Communicator
 9. Warranty two years
 10. Approved Manufacturer: Onicon Flow Meter F1200 Series
- B. Electromagnetic Flow Meter
1. Retractable hot tap flow sensor
 2. Accuracy: +/- 1% of full scale
 3. Electromagnetic
 4. Custom thread-o-let 400 psi / 250-degree F rated.
 5. Line size from 1-1/4 to 72 inch
 6. Metering ranges from 0.3 to 15 f/sec.
 7. Remote NEMA 4 wall mounted LCD display
 8. Field Pro Software & Communicator
 9. Warranty two years
 10. Approved Manufacturer Onicon Flow Meter F3500 or FT3500

2.28 CONTROL DAMPERS

- A. Opposed blade dampers.
1. Frames of 13-gauge galvanized sheet metal.
 2. Provisions for duct mounting.
 3. Damper blades not exceeding 8" in width.
 4. Blades of two sheets of 16-gauge galvanized sheet metal.
 5. Blades suitable for high velocity performance.
 6. Bearings of nylon or oil-impregnated, sintered bronze.
 7. Shafts of 1/2" zinc-plated steel
 8. Leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure.
 9. Replaceable resilient seals along top, bottom and sides of frame and blade edge.
 10. Submit leakage and flow characteristics data with shop drawings.
 11. Linkage shall be concealed out of the air stream within damper frame.
 12. Acceptable Model is Ruskin Model CD60.

2.29 PHOTO-CELL CONTROL

- A. Light Sensitive Resistor.
1. 4-20 output or switch.
 2. On = 3.0 / fc. Off 10.0 / fc.
 3. UL Approved.

2.30 DRAIN PAN FLOAT SWITCH

- A. Rated at 10 Amps.
1. Shuts off equipment if water level becomes too high.
 2. DPDT Contacts.

2.31 BY-PASS AUTOMATIC SHUT-OFF TIMERS

- A. Rated at 10 Amps, 125 VAC
1. Shuts off equipment with timed switch
 2. White decorated timer

3. Without hold feature
4. Time Cycle 60 minutes

2.32 CO₂ SENSOR

- A. Telaire Model T5100 CO₂/Temperature Sensor or approved equal
 1. Local visual indication of CO₂ levels in enclosed spaces.
 2. Pre-calibrated with factory default settings of 1000 ppm and 1500 ppm CO₂ levels
 3. Bright LED indicator transitions between green, yellow, and red as the CO₂ threshold is exceeded.
 - a. Accuracy: +/- 30 ppm @ 72°F
 - b. Output: 0-10 V (100Ω output impedance) and NTC 20k Thermister

2.33 AIR FLOW SENSING SWITCH

- A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system positive, negative, or differential pressure.
 1. Select the pressure range based on the sensed differential pressure.
 2. The unit shall be protected against overpressure to the full static pressure rating.
 3. Accuracy: +/- 2% of full scale
- B. Switch assembly:
 1. Reed switch
 2. Field adjustable setpoint
 3. Threaded boss conduit entrance
 4. SPST Action
 5. Voltage and rating as required for the control circuit

2.36 HVAC SHUTDOWN STATION

- A. Lockdown Switch:
 1. Mushroom Red Button within a clear plastic cover
 2. Latches when depressed
 3. Twist reset
 4. Sign "HVAC SHUTDOWN"
 5. Manufactured by STI Model #SS2031HV-EN

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The control system shall be installed, and final adjustments made by full-time employees of the factory approved BMCS Building Management Control Subcontractor.
- B. The contractor shall collaborate through Architect / Engineer and Owner to determine the Owner's preference for naming conventions, etc. before entering the data into the system.
- C. Due to actual operational or space conditions, it may be necessary for the Contractor to

make sequence of operation modifications and/or controller adjustments, change the location or type of sensor to obtain proper operation and coverage of the system in each room or space. These change, if requested by the Owner or Engineer, shall be performed at no additional cost to the Owner. Therefore, labor allowances should be made for such changes and adjustments if requested.

- D. Points listed within this section are to be connected to the BMCS system as hard-wired points to cards and not connected through BacNet integration. The BacNet interface is for read only points not included within sequences of this specification.

3.2 INTERLOCK AND SAFETY CIRCUITS

- A. Close the outdoor air dampers when the related HVAC unit supply or exhaust fan is de-energized:
1. The damper and actuators are specified in this section.
 2. Outdoor air damper shall be fully opened before related air handling unit fan is energized for 100% outside air use.
 3. Provide motorized outside air dampers for the following:
 - a. Supply fans
 - b. AHUs
 - c. Exhaust fans (except kitchen exhaust)
- B. Close the chilled and hot water valves to the coil when the related unit is de-energized.
- C. Interlock each chiller to start its dedicated chilled and condenser water pumps.
1. On shutdown provide a circuit to permit the chilled water pumps and condenser water pumps to run while the chillers pump down as required by the manufacturer.
 2. As per manufacturer's recommendations
- D. Primary chilled water control:
1. Operating and safety controls are furnished as an integral part of the water-chilling unit and not specified in this section.
 2. Provide a high limit temperature sensor in each primary chilled water pump loop.
- E. Exhaust/Supply Fans:
1. Interlock the related exhaust and supply fans and the related outside air damper.
 2. Interlock the exhaust fans with the related air-handling unit through software.
 3. Interlock related exhaust fan for dishwasher with time delay off relay.
 4. Interlock related exhaust fan for kiln with time delay off relay
 5. Interlock kitchen hood related supply and exhaust fans.
 6. Provide additional interlocks as indicated on fan schedule and on drawings.
 7. Interlock electrical and mechanical room exhaust fans with thermostat.
 8. Interlock refrigerant monitor with mechanical room purge system.
 9. Interlock science room related supply and exhaust fans.
 10. Interlock outside air supply fans for VAV air-handling unit with air-handling unit status point.
- F. Cooling Tower Fan Safety Interlock: Provide interlock wiring for the vibration sensor, oil level switch and oil pump on each cooling tower fan.

G. Freeze Protection:

1. Provide a freeze protection sequence to ensure proper operation of equipment during a freeze condition not limited to the following:
 - a. Outside Air Handling Units & Supply Fans with heating and cooling coils: If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, open both heating and cooling valves to enable full flow condition. If heating coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition, disable unit, close outside air damper, and open both heating and cooling valves to enable full flow condition. Ensure HW & CHW pumps are operational.
 - b. Boilers - Enable during a freeze condition.
 - c. Cooling Tower – Open isolation valves then command by-pass valve to dump water into basin or by-pass tower. Enable condenser water pumps during a freeze condition.
 - e. Protect coils downstream of DX cooling coil with freeze protection. If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, disable the DX cooling coil. If coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition.
2. Temperature low limit switch wired with double pole single throw switch with one switch leg hard-wired to de-energize fan and one switch leg to signal BMCS.

H. Drain Pan Float Protection:

1. Interlock to shut down unit and close valves.
2. Cooling Coils mounted above ceiling and in roof mounted units.
3. Provide for each cooling coil location.
4. Signal BMCS alarm point

I. Domestic Water System:

1. Interlock in-line circulating pumps at water heaters with return water pipe mounted thermostat to cycle pump with return water temperature.
2. Interlock high temperature entering water solenoid valve with thermostat on discharge side of tempered water mixing valves.

J. Emergency Shutdown Station:

1. Provide an emergency mushroom style push / pull station shutdown switch in the Administration Area or as directed by Owner / Architect.
2. Signal the building automation system to de-energize the HVAC equipment.
3. This is to stop exhaust fans and outside air units immediately.
4. Other air handling units, chillers and equipment shall be shut down in an orderly manner so as to not damage the equipment.
5. Once stopped, the system may only be restarted with a key operated switch located adjacent to the shutdown switch.

- N. Condensing Hot Water Boilers:
 - 1. Interlock each boiler to start its dedicated pump.
 - 2. Install communication cable between each boiler and master controller specified by boiler manufacturer.
- O. Intrusion Alarm System:
 - 1. Interlock the intrusion alarm system for status of building occupancy.
 - 2. Disable HVAC system when building is in the unoccupied mode and alarm system is enabled. Either Time of Day Schedule and/or contact from the intrusion alarm system shall disable HVAC system.

3.3 GRAPHICS

- A. Furnish as-built drawings indicating finally corrected "as installed" diagram(s) of the complete Building Management Control System.
 - 1. Modification of existing control systems shall be included.
 - 2. These must be as-built and any changes during the warranty period drawings must be revised and updated.
 - 3. Provide final sequence of operation in written format.
- B. Provide a set of the "as installed" diagram(s) of the complete control system laminated in plastic and hung in the main mechanical room or as directed by Owner.
- C. Provide a color-coded floor plan of the building showing the location of each system, and the area served by each AHU or related zone. These must be of professional quality. Floor plan is to hang in main mechanical room near central control panel.
- D. Provide computer graphics for each system.
- E. Provide final graphic room numbers as selected by Owner / Architect. Obtain a graphic submittal package for review. Construction Drawing room numbers are not to be used unless approved in writing.

3.4 IDENTIFICATION

- A. Provide a laminated engraved nameplate on all control panels and devices shown on the "as installed" control diagrams. Coordinate engraving with nomenclature used on the diagrams.
- B. A black-white-black laminated plastic engraved identifying nameplate shall be secured to each terminal cabinet, and control panels. Identifying nameplates shall have ½ inch high, engraved letters.
- C. A red-white-red 2"x8" laminated plastic engraved identifying nameplate shall be secured to each audible/visual alarm and emergency shutdown device. Provide identification and location of each A/V device laminated in plastic and hung at refrigerant monitor with identification, location of devices and proper operation of system in a graphic floor plan with written sequence of operation. Identifying nameplates shall have ½ inch high, engraved letters. A red-white-red 12"x12" laminated plastic engraved identifying nameplate shall be secured to outside of each door to machine room with "A REFRIGERANT

LEAK HAS BEEN DETECTED IN THIS BUILDING WHEN AUDIBLE/VISUAL ALARM IS ENABLED. DO NOT ENTER. CONTACT MAINTENANCE DEPARTMENT.”

- D. A black-white=black laminated plastic engraved identifying nameplate shall be secured to ceiling grid directly below the control panel. Identifying name plates shall have ½” inch high engraved letters. White with black letters.

3.5 WIRING FOR BUILDING MANAGEMENT AND CONTROL SYSTEMS

- A. Furnish and install all wire, conduit, raceways, and cable systems required for the complete operation of the Building Management and Control System.
- B. All wiring for the Building Management and Control System is specified in this section and includes, but is not limited to:
 - 1. Wiring of interlock system.
 - 2. Wiring of control instruments.
 - 3. Wiring of control panels.
 - 4. Wiring of related power supplies, i.e. transformers.
 - 5. Wiring of 120 VAC power circuits for control panels and devices.
- C. All materials and methods specified in this section shall comply with the requirements specified in Division 26 of this specification.
- D. All power supply requirements shall be connected to the building electrical distribution system in an approved manner. Do not connect control equipment of circuits common with other building loads or devices.
- E. Temperature control wiring shall be jacketed cables installed with or without conduit as specified below or single conductors installed in conduit. Control wiring shall have minimum 300V insulation for low voltage wiring and 600V insulation for line voltage wiring.
- F. All line voltage control wiring, all low voltage control wiring which is exposed in the central plant, penthouse, and other similar spaces; all low voltage control wiring which is routed through concealed inaccessible locations shall be installed in conduit.
- G. All low voltage control wiring which is routed through concealed accessible locations may be run without conduit provided that the wiring run without conduit is properly supported from the building structure on maximum 5' centers and does not depend upon the ceiling grid or the ceiling support system for support. Wiring run in plenum spaces shall be plenum rated. Support all plenum wiring in accessible locations in bridge rings, J-hooks, D rings. Plenum wiring is not to be supported within building structure or attached to conduit raceways. All low voltage wiring must be installed through supports. Wires shall be supported on 5' centers and identified at each termination point and at 50' centers minimum. Install wire parallel or perpendicular to the structural features of the building.
- H. Line and low voltage control wiring shall not be installed in the same conduit with control wiring and shall not be installed in the same conduit with power wiring.

- I. All wiring associated with building management and control system cover shall be as follows:
 1. Sensor jacket color, Green
 2. LAN communications, Yellow
 3. All THHN wiring shall comply with Division 26 insulation color identification

3.6 EXHAUST FANS

- A. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.
- B. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.7 SYSTEM OVER-RIDE

- A. Provide manual over-ride push buttons and pilot lights installed in a single control panel at the main central plant for all functions.
 1. Overrides shall be located within a locked panel.
 2. Provide override switch for:
 - a. Chilled water central plant
 - b. Hot water central plant
 - c. Each Air Handling unit
 - d. Existing systems
 - e. Exhaust Fans

3.8 BUILDING ELECTRICAL USAGE

- A. Provide digital monitoring of the building KVA and KWH. Coordinate with the switchgear manufacturer.
- B. Electrical Quality monitoring:
 1. Monitor Watts, VA, VAR, Demand, Imbalance, and Power Factor.

3.9 MISCELLANEOUS

- A. Freezer/Cooler Temperature Monitoring:
 1. Provide an analog temperature sensor located in the freezer compartment and cooler compartment.

POINT DESCRIPTION	TYPE	DEVICE
Freezer Alarm	AI	RTD
Cooler Alarm	AI	RTD

B. Lighting Control:

1. Provide individual time/photo-cell and time based control of each lighting contactor specified in Division 26.
2. Provide momentary push buttons located at the central plant control panel, tennis courts, football, baseball, softball fields and/or concession stands to energize exterior lighting for a preprogrammed length of time.
 - a. Provide separate control of each contactor.

POINT DESCRIPTION	TYPE	DEVICE
Lighting Contactor	DO	Control Relay
Momentary Control Switch	DI	Switch

C. Photocell: Provide a photocell mounted on the north side of the building. Location is to be approved by Owner / Architect / Engineer.

POINT DESCRIPTION	TYPE	DEVICE
Photocell	AI	Contact

D. Humidity Sensor: Provide a sensor in Library to monitor space conditions.

POINT DESCRIPTION	TYPE	DEVICE
Humidity	AI	Space Sensor

E. Outside Air: Provide a temperature sensor and a humidity sensor to monitor outside air conditions.

POINT DESCRIPTION	TYPE	DEVICE
Outside Temperature	AI	Thermistor
Outside Humidity	AI	Humidity Sensor

3.13 HOST COMPUTER REQUIREMENTS

- A. Provide a new Building Management and Control System host computer with printer located in the buildings maintenance management office.
 - 1. Provide modem for management tasks.
 - 2. Make final connections necessary to provide a complete and functioning system.
- B. Provide color graphics software. Complete graphics of all systems specified in this contract.

3.16 VARIABLE FREQUENCY DRIVE INTERFACE

- A. Interface to the VFD directly
- B. Interface may be hardwired or via RS-485
- C. The following points shall be available at a minimum:

<u>Point Name</u>	<u>Type</u>
Start-stop	DO
Drive alarm	DI
Last fault	AI
Reset drive	DO
Percent output	AI
Frequency output	AI
Speed	AI
Current	AI
Power	AI
Drive temperature	AI
KWH	AI
Run time	AI

OUTSIDE AIR – AIR HANDLING UNITS

3.27 OUTSIDE AIR HANDLING UNIT CONTROL

- A. These units are furnished with a chilled water coil and a hot water heating coil in the PREHEAT position. Control shall be as follows:
 - 1. A duct mounted sensor sensing supply air temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired discharge air temperature of 55°F. The air-handling unit shall be started and stopped from the BMCS System.
 - 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the

temperature drops below 32°F. Device shall be manual reset.

3. Open OA damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Duct Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch
HW Pre Heat Valve	AO	Electronic Operator

3.28 OUTSIDE AIR – AIR HANDLING UNITS

- A. These units consist of a hot water preheat coil, chilled water cooling coil and a hot water reheat coil. Control shall be as follows:
 1. A temperature sensor located in the discharge of the hot water preheat coil shall, through the Direct Digital Control Panel, modulate the hot water control valve to maintain a 55°F discharge temperature (adjustable).
 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil to de-energize the air-handling unit when the temperature drops below 37°F. Device shall be manual reset and signal an alarm to the BMCS. Provide freeze protection sequence.
 3. A temperature sensor located in the discharge of the air handling unit shall, through the Direct Digital Control Panel, modulate the hot water reheat control valve and chilled water control valve to maintain setpoint. Reference the schedule for discharge temperature requirements.
 4. Open O.A. Damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Discharge Thermistor

POINT DESCRIPTION	TYPES	DEVICE
HW Reheat Valve	AO	Electronic Operator
HW Preheat Valve	AO	Electronic Operator
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch

3.29 OUTSIDE AIR HANDLING UNIT CONTROL

- A. These units are furnished with a chilled water coil and an electric duct heater in the duct supplying the unit. A duct mounted sensor sensing supply air temperature shall, modulate the valve on the cooling coil and stage the electric duct heater in sequence to maintain the desired supply temperature of 55°F. The air-handling unit shall be started and stopped from the BMCS System.
- B. Provide a temperature low limit switch located on the discharge side of the electric duct heater to de-energize the air-handling unit when the temperature drops below 37°F. Close the outside air damper, activate the duct heater 100%, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset. Provide freeze protection sequence.
- C. Open O.A. damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Duct Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch
Electric Heater	DO	Relay each stage

3.30 DX OUTSIDE AIR UNITS

- A. These units are furnished with a direct expansion coil and electric heating coil in the reheat position. Control shall be as follows:
1. An ambient temperature sensor shall energize the first stage of cooling whenever the ambient temperature rises above 56°F (adjustable) and energize the second stage of cooling whenever the temperature is above 76°F (adjustable).
 2. De-energize the DX cooling whenever the ambient temperature is below 55°F (adjustable).
 3. Internal unit controls shall operate the hot gas bypass and defrost safeties as required.
 4. A discharge air temperature sensor shall stage the electric duct heat to maintain 55°F.
 5. Start/stop of the unit shall be by BMCS.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Condensing Unit	DO	Control Relay(s)
Discharge Air Temperature	AI	Discharge RTD
Electric Heater	AO	Relay(s)
Status	DI	Air Flow Switch
Outside Air Damper	DO	Electronic Operator
Ambient Temperature	AI	Thermistor

ROOF TOP UNITS

3.31 PACKAGED ROOFTOP UNIT

- A. Controller: The unit shall be governed by a programmable controller capable of seamless communication with the building automation system (BAS). The controller will initiate the unit via a predetermined optimum start sequence through bas controls and will de-energize the unit in accordance with time schedules managed by the bas. The manufacturer shall supply a factory-mounted controller, complete with all necessary sensors, wiring, and controls to ensure the proper execution of the specified sequence of operations.
- B. Morning Warm-up/Cool Down Mode: On a signal from the BAS, the unit controls shall optimally start the unit and energize the DX cooling or gas furnace to reach occupied setpoint by the scheduled occupied time.
- C. Occupied Mode: On a signal from the BAS, the supply air fan shall operate continuously, and the

associated outdoor air modulator shall modulate to the balanced position. On a signal from the BAS through the space-mounted temperature sensor, the unit shall enter cooling or heating mode. During cooling mode, the DX cooling shall sequence to maintain a space temperature setpoint of 72°F (adjustable). During heating mode, the gas furnace shall stage to maintain a space temperature setpoint of 70°F (adjustable).

- D. Dehumidification: On a signal from the BAS through the space-mounted humidity the unit shall enter dehumidification mode. The unit shall modulate the hot gas reheat and the unit controller shall energize and stage the DX cooling to maintain a humidity setpoint of 50% RH (adjustable).
- E. Economizer control (enthalpy control): When the outside air enthalpy (global point) is less than the return air enthalpy and there is a request for cooling, economizer mode will be enabled. During economizer mode, the supply cooling signal will modulate the dampers as required to satisfy the current cooling setpoint. If the outside air damper is open 100% and the setpoint cannot be met, then additional cooling control will be enabled. As the mixed air temperature varies within the range of 55°F to 45°F, the outside air damper will modulate closed as required to prevent excessively cold supply air. Measure OSA flow to maintain minimum flow.
- F. Demand control ventilation – On a signal from the BAS through the space-mounted carbon dioxide sensor that the space has exceeded the set carbon dioxide space minimum. The space carbon dioxide sensor shall signal the unit controller through the bas and the unit controller shall modulate the outside air damper opened or closed until space carbon dioxide sensor has been satisfied.
- G. Unoccupied mode: On a signal from the BAS, the supply air fan shall cycle, and the associated outdoor air mod shall modulate fully closed. The DX cooling or gas furnace shall modulate as required to maintain setback temperature.
- H. Safeties and auxiliary controls:
- Phase failure protection.
 - Condensate overflow switch.
 - Filter alarm (when filter differential is greater than 1" wc, manually adjustable).

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Relay
Cooling Stages	DO	Relay
Heating Stages	DO	Relay
Supply Fan Start/Stop	DI	Relay
Supply Fan Status	DI	Relay
Supply Fan Flow	AI	Air Flow Sensor
Outdoor Air / Return Air Damper Command	AI	Relay
Outdoor Air / Return Air Damper Position Feedback	AI	Relay
Space Temperature	AI	Temperature Sensor
Space Humidity	AI	Humidity Sensor
Condensate Overflow	DI	Relay

Filter Alarm	DI	Relay
Return Air Temperature	AI	Duct Thermistor
Return Air Humidity	AI	Humidity Sensor
Outdoor Air Temperature	AI	Duct Thermistor
DX Cooling Status	DI	Relay
Gas Furnace Status	DI	Relay
Discharge Air Humidity	AI	Humidity Sensor
Discharge Air Temperature	AI	Duct Thermistor

FAN COIL UNITS

3.47 DX FAN COIL UNITS

- A. Each fan/coil unit is furnished with a direct expansion coil. Control shall be as follows:
1. A space temperature sensor shall, acting through a terminal equipment controller, stage the DX cooling coil to maintain the desired space temperature.
 2. Start/stop of fan coil unit shall be by terminal equipment controller.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Condensing Unit	DO	Control Relay
Space Temperature	AI	Space Thermistor
Status	DI	Current Relay
Discharge Air Sensor	AI	Duct Thermistor

HEATERS

3.50 ELECTRIC UNIT HEATERS

- A. An electric thermostat shall activate the unit and stage the electric coil to maintain room setpoint.

3.51 ENERGY RECOVERY UNIT

- A. Each ERU has its own controls. BMCS shall enable unit and open outside air and exhaust air damper. Interlock ERU with the related air handling units.
- B. The BMCS controls for energy recovery unit shall function as follows:
1. The system shall be automatically started and stopped by the BMCS panel

whenever the hand-off-automatic switch is in the automatic position, and manually started and stopped by the hand position. The unit shall run when either AHU is enabled.

2. The energy recovery unit's internal controls shall be energized, and the dampers shall open prior to starting the energy recovery unit outside air and exhaust fans.
3. The internal controls shall start the energy recovery unit wheel rotation and modulate the wheel speed to maintain a leaving outside air temperature of 56° F in the winter mode and 79° F in the summer mode but not exceeding 50% relative humidity.
4. The energy recovery unit's internal controls shall shut down fans upon receiving a signal from the BMCS panel showing the AHU's are disabled.
5. On power interruption or fan shutdown, all the dampers shall close.
6. Smoke detector in the outside air duct downstream of the energy recovery unit shall automatically shut down the fans.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop OA Fan	DO	Control Relay
Status OA Fan	DI	Current Relay
Start/Stop EF Fan	DO	Control Relay
Status EF Fan	DI	Current Relay
Energy Recovery Wheel VFD	DO	Control Relay
Energy Recovery Wheel VFD Status	DO	Control Relay
Entering OA Temp	AI	Thermistor
Entering OA Humidity	AI	Relative humidity sensor
Leaving OA Temperature	AI	Thermistor
Leaving OA Humidity	AI	Relative humidity sensor
Entering EA Temperature	AI	Thermistor
Entering EA Humidity	AI	Relative humidity sensor
Leaving EA Temperature	AI	Thermistor
Leaving EA Humidity	AI	Relative humidity sensor
Differential Across Filters	DI	High / Low limit Switch

POINT DESCRIPTION	TYPES	DEVICE
EA & OA Dampers	DO	Control Relay

3.52 WATER SOURCE HEAT PUMPS

A programmable controller capable of stand-alone operation will control the unit. The constant volume water source heat pump will be started via pre-determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS.

General: See the Water Source Heat Pump schedule for unit configurations and requirements.

Unoccupied Mode: The supply fan will be indexed off and will remain off until the start of night high limit, night low limit, warmup, cooldown, or occupied mode. The outside air damper will remain closed. Loop requests are generated by the heat pumps during unoccupied periods if the WSHPs enter Warmup, Cooldown, NHL, or NLL modes.

Night Low Limit Mode (NLL): On a drop in space temperature below the night low limit setpoint (NLL, 55°F adj.), the supply fan and space temperature heating control will be enabled. When the space temperature increases above the NLL setpoint and the NHL/NLL minimum runtime has expired (2 hrs, adj.); or the occupied schedule becomes active, NLL will be disabled.

Night High Limit Mode (NHL): On a rise in space temperature above the night high limit setpoint (NHL, 85°F adj.) the supply fan and space temperature cooling control will be enabled. When the space temperature decreases below the NHL setpoint, and the NHL/NLL minimum runtime has expired (2 hrs, adj.); or the occupied schedule becomes active, NHL will be disabled.

Warmup Mode: An optimum start algorithm will determine how early the unit needs to enable to satisfy the occupied heating setpoint before the scheduled occupied mode begins. In warmup mode, the supply fan and space temperature heating control will be enabled. When the occupied schedule becomes active warmup mode will be disabled and the unit will begin occupied mode control.

Cooldown Mode: An optimum start algorithm will determine how early the unit needs to enable to satisfy the occupied cooling setpoint before the scheduled occupied mode begins. In cooldown mode, the supply fan and space temperature cooling control will be enabled. When the occupied schedule becomes active cooldown mode will be disabled and the unit will begin occupied mode control.

Afterhours Mode: On a call for afterhours operation, by pressing the center of the wall mounted space temperature sensor, the supply fan will be enabled, and the unit will control as if it were in occupied mode. The unit will stay in afterhours override until the override timer expires or until the start of an occupied cycle; whichever occurs first. The override time (2 hrs.) can be adjusted at the Operator's Workstation.

Occupied Mode: The supply fan will be enabled and will run continuously.

Space Temperature Control: Heating and cooling signals will generate based on the deviation of the space temperature from current space temperature heating and cooling setpoints. On a drop in space

temperature below the current heating setpoint, the unit will enter heating mode. On a rise in space temperature above the current space temperature cooling setpoint, the unit will enter cooling mode.

Space Humidity Control: On a raise in space humidity above the current humidity setpoint (60% RH), the unit will enter dehumidification mode. The unit shall remain in dehumidification mode until space humidity is stratified.

Compressor Control: The compressor will enable based on the space heating and cooling signals. In cooling mode, the reversing valve will be commanded to the cooling position. As the cooling signal increases, the compressor will enable. In heating mode, the reversing valve will be commanded to the heating position. As the heating signal increases, the compressor will enable. Once enabled, the compressor will stay commanded for a minimum ON time of 5 minutes (adj.). After the compressor has disabled, it will not be commanded to run again for a minimum OFF time of 3 minutes (adj.).

Alarms: The following software alarms will be generated and displayed at the Operator's Workstation:

- Space Too Warm (3°F greater than cooling setpoint)
- Space Too Cold (3°F less than heating setpoint)
- Bad Space Temp Sensor Alarm (greater than 120°F or less than 40°F)
- High Supply Air Temp (greater than 180°F)
- Low Supply Air Temp (less than 45°F)
- Bad Supply Temp Sensor Alarm (greater than 180°F or less than -20°F)
- Supply Fan Alarm (command with no status)
- Filter Alarm (when runtime exceeds 3000 hours, (adj.))

Safeties: The following safeties will be monitored as a status input and will be displayed at the Operator's Workstation:

- Condensate Switch: A Condensate Switch will, when activated, disable the unit.
- Condenser Water Loop System Fault: The unit will shutdown if the Heat Pump Water Loop System temperature > high temperature shutdown setpoint (95°F, adj.) or < low temperature shutdown setpoint (55°F, adj.), or if both Loop Water Pumps (P-1, P-2) fail.

Manual System Operation: In the event of DDC failure, the system can be operated in manual ("Hand") mode. The supply fan can be started manually through its H-O-A switch.

3.51 WATER LOOP SYSTEM

A programmable controller capable of stand-alone operation will control the Water Loop System. The Water Loop system will be indexed to run through the Building Automation System (BAS). Once enabled the boilers will operate under their own factory supplied controls, safeties, and interlocks using the manufacturer's sequence_of operation. Pertinent points will be monitored and displayed at the Operator's Workstation.

General: The Water Loop control system consists of a heating loop and a cooling loop. The heating loop is comprised of two boilers with their own heating loop pumps. Hot water supply temp is regulated by a HW mixing valve. The cooling loop is comprised of one evaporative cooler with its own pumps and a heat exchanger. Two condenser water loop distribution supply the Water Loop.

Condenser Loop Pumps (P-1, P-2): The condenser loop pumps are variable speed pumps setup in a

lead/standby configuration. The lead pump shall be enabled during occupied hours, if a unit is in afterhours mode, or a minimum number of loop requests (5 requests, adj.) are met. The lead pump shall be rotated on a weekly basis by the BAS. On failure of the lead pump to run once indexed on the lead pump command will be disabled and the lag pump will be enabled.

Heating Loop Control:

Boiler Pump Control:

1. The boiler circulation pumps are constant speed pumps setup in a lead/standby configuration. The lead pump shall be enabled by the BAS when the hot water system is enabled. The lead pump shall be rotated on a weekly basis by the BAS. On failure of the lead pump to run once indexed on the lead pump command will be disabled and the lag pump will be enabled. Once a heating loop pump status is proven the lead boiler recirculation pump will be enabled. Once a boiler recirculation pump is enabled, its associated boiler will enable 30 seconds later. If a boiler has been enabled to run for 15 minutes (adj.) and the condenser loop return temperature is below 55°F (adj.) or the hot water supply temperature is below 100°F (adj.), the lag boiler recirculation pump will be enabled. If the lag pump is enabled because of a low hot water supply temperature, a lead boiler failure alarm will generate.

Boiler Control:

2. The boiler controls shall be indexed to run when the condenser loop water return temperature is <60° F (adj.). The boilers shall be disabled when the condenser loop water pump (P-1, P-2) is disabled, when the evaporative cooler is enabled or when outside air temperature is >50° F (adj.). The boiler water pump shall be indexed to run when a boiler is activated. Upon activation, after the purge cycle is completed, the burner shall start at low fire and the temperature control valve (V1) shall open to a minimum position (10%, adj.). Each boiler shall be set to maintain the water temperature leaving the boiler at 85° F. Low load condition shall allow only one boiler to operate with water circulating through both boilers at the same time. The lag boiler shall be activated when the circulated mixed water temperature entering the boilers is <60° F (adj.). The lag boiler shall be deactivated when the circulated mixed water temperature entering the boilers is >80° F (adj.). The BAS will alternate the boilers on a weekly basis to determine the lead boiler.

Mixing Valve Control (V2):

3. The HW loop mixing valve (V2) will modulate as necessary to maintain the condenser loop return temperature heating setpoint 75° F(adj.). If the HW loop mixing valve is fully closed to the loop (not supplying any HW) for 10 minutes (adj.) and the condenser loop water return temperature continues to rise, the heating loop will be disabled.

Evaporator Loop Control: The evaporative cooler pump is a constant speed pump. Once condenser loop pump status is proven and the condenser loop water return temperature rises above the cooling setpoint 80°F (adj.) the lead evaporative cooler pump will be enabled. On failure of the pump to run once indexed from the BAS, the BAS shall be alarmed. Enabling the evaporative cooler pump will be the first stage of cooling. If the condenser water temperature continues to rise after 10 minutes (adj.), the evaporative cooler fan will be enabled on low speed. If temp continues to rise after another 10 minutes (adj.), the evaporative cooler fan will be enabled on high speed.

The evaporative cooler pump and evaporative cooler fan will disable will when the condenser return temperature drops below 75°F(adj.), for 10 min.(adj.).

Temperature Control: The temperature control valve position shall be limited so that water temperature

leaving the boiler is >95° F or water entering the boiler is >70° F. The temperature control valve (V1) shall remain closed to HWS when the boilers are not in operation.

Freeze Protection: If outside air temperature falls below 35° (adj.) the heating loop pumps shall be enabled, and the boilers shall be enabled.

Alarms: The following software alarms will be generated and displayed at the Operator's Workstation:

- Heating Loop Pump Failure (BP-1) (command with no status)
- Heating Loop Pump Failure (BP-2) (command with no status)
- Heating Loop Pump Failure (BP-1) "In Hand" (status with no command)
- Heating Loop Pump Failure (BP-2) "In Hand" (status with no command)
- Loop Water Pump Failure (P-1) (command with no status)
- Loop Water Pump "In Hand" (P-2) (status with no command)
- Cooling Tower Pump Failure (CP-1) (command with no status)
- Cooling Tower Fan Failure (command with no status)
- Bad Heat Pump Loop Supply Temp Sensor (greater than 180°F or less than -20°F)
- Bad Heat Pump Loop Return Temp Sensor (greater than 180°F or less than -20°F)
- Bad Cooling Tower Return Temp Sensor (greater than 180°F or less than -20°F)
- Low Hot Water Supply Temp (<95°F, adj.)
- High Hot Water Supply Temp (>185°F, adj.)
- Low Loop Water Supply Temp (<55°F, adj.)
- High Loop Water Supply Temp (>95°F, adj.)
- Low Cooling Tower Water Supply Temp (<55°F, adj.)
- High Cooling Tower Water Supply Temp (>95°F, adj.)

3.71 CONDENSER WATER CONTROL

- A. A sensor located in the condenser water supply shall, through a DDC panel:
 - 1. Modulate the three-way valve located in the condenser water piping.
 - 2. When the three-way control valve is in the full cooling position with all the water flowing over the tower and no water being by-passed enable the tower fan.
 - 3. Cycle the tower fan to maintain water temperature entering each condenser at 85°F.
 - 4. As the temperature decreases cycle the fan to the off condition and modulate the three-way control valve towards the by-pass position.
- B. Controller sequence:
 - 1. Throttling range: - 20°F.
 - 2. Set point: 85°F (adjustable)
 - 3. At set point the condenser water shall be full flow to the tower riser.
 - 4. Maximum condenser water supply: 85°F.
 - 5. Energize the tower fan at 82°F.
- C. Provide wiring for vibration switch, with manual reset, to de-energize the fan in the event of a sensed malfunction.
 - 1. Set limits as recommended by the tower manufacturer.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop Pump	DO	Control Relay
Start/Stop Tower Fan	DO	Control Relay
Tower Bypass Valve	AO	Electronic Operator
Status (Pumps)	DI	Current Sensitive Relay
Status (Tower Fan)	DI	Current Sensitive Relay

3.73 CONDENSER WATER SYSTEM BYPASS

- A. The system consists of chilled water system pressure sensors and a system bypass valve controlled as follows:
1. A system differential pressure sensor shall modulate the condenser water bypass valve to maintain system pressure.

POINT DESCRIPTION	TYPES	DEVICE
System Differential Pressure	AI	Pressure Sensor
Bypass Valve	AO	Electronic Operator

3.78 CHEMICAL TREATMENT SYSTEM

- A. Monitor water treatment power circuit and alarm contacts from water treatment controllers. Provide with cooling tower systems only.

3.82 START-UP AND POINT VERIFICATION

- A. Final startup and point verification shall include the following information.
1. Field panel checkout:
 - a. Verify enclosure is not mounted on vibrating surface.
 - b. Verify class I and class II wiring is separated within enclosure.
 - c. Check for shorts/grounds/induced voltages/proper voltages.
 - d. Verify proper point terminations in accordance with as-builts.
 - e. Verify that all modules are in proper place and addressed.
 - f. Verify proper power voltage.
 - g. Load database and programming.
 - h. Startup the panel.
 - i. Point and device checkout.
 2. Analog input point checkout:
 - a. Verify the correct wiring terminations per the design documentation

- package, at the field panel. Verify that all wiring and terminations are neat and dressed.
 - b. Verify the point address by checking that the analog input instrument is wired to the correct piece of field equipment. Do this by altering the environment at the sensing element or by disconnecting one of the wires at the sensor, and verifying that the reading at the field panel has reacted to this change.
 - c. Verify the point database to be correct, (i.e., alarmability, alarm limits, slope/intercept, engineering units, etc.). Verify that the correct change of value (COV) limit has been defined.
 - d. Verify the sensor has the correct range and input signal. (i.e., 20-120°F, 4 - 20 ma). Verify that the device is mounted in the correct location and is wired and installed correctly per the design documentation package.
 - e. Set-up and/or calibrate any associated equipment (i.e., panel LCD meters, loop isolators, etc.). Verify that these auxiliary devices are mounted in the correct location and are wired and installed correctly per the design documentation package.
 - f. Verify the correct reading at the field panel using appropriate MMI devices. Verify that any associated LCD panel meters indicate the correct measured value.
- 3. Digital input point checkout:
 - a. Verify the device is correctly wired and terminated as shown in the design documentation package. Verify that all wiring and terminations are neat and properly secured.
 - b. Verify the point address by verifying that the digital input is correctly terminated at the controlled piece of equipment.
 - c. Verify the point database is correct (i.e., point name, address, alarmability, etc.).
 - d. Set-up and/or calibrate the associated equipment, i.e. smoke detector, high/low temp detector, high/low static switch, end switch, current relay, pressure switch, etc. is mounted in the correct location, and is wired and installed correctly per the control system installation drawings.
 - e. With the controlled equipment running or energized as described in the digital output checkout procedures, verify the correct operation of the digital input point and associated equipment by putting the digital input monitored equipment into its two states. Verify that the proof or status point indicates the correct value at the operator's terminal and that the status led is giving the proper indication in each mode of operation (on/off).
- 4. Digital output point checkout:
 - a. Verify that device is correctly wired and terminated as shown in the design documentation package.
 - b. Verify that the correct voltage is utilized in the circuit.
 - c. Verify the point database to be correct (i.e. point name, address, etc.).
 - d. Check and verify that the end device responds appropriately to the digital output(s).
 - e. After verifying the set-up and operation of any associated digital input/proof points, check and verify correct operation of the logical point and associated equipment by commanding the point to all possible states (i.e. off, on, fast, slow, auto, etc.). Verify that the defined proof delay is adequate for all modes of operation.
 - f. If any interlocked equipment exists that has independent hand-off-auto or

- g. Verify that the controlled piece or pieces of equipment cannot be caused to change state via the digital output if an associated hand-off-auto switch is in the hand/on or hand/off mode of operation, unless specified as a fireman's override point etc.
5. Analog output point checkout:
 - a. Verify the correct wiring or piping terminations per the design documentation package, at the field panel. Verify that all wiring and piping terminations are neat and dressed.
 - b. Insure that the correct output device(s) are installed per the Control System Installation Drawings. (i.e., I/P or P/I transducers, transformers, power supply, etc.). Verify that these devices are installed, wired and piped correctly. Verify that any configuration jumpers are in the proper settings for the required application. Verify related transformers are fused in accordance with installation drawings.
 - c. Verify the point database to be correct. Verify that the correct COV limit has been defined.
 - d. Verify the point address by checking that the analog output is wired and/or piped to the correct output transducer and/or equipment.
 - e. Verify that the controlled device is calibrated (i.e., 3-8PSI valve, 8-13 PSI damper motor, 4-20 ma variable frequency drive, etc.) and is in the correct location, and is wired or piped and installed correctly per the design documentation package. If the controlled device is not calibrated, then a three-point (high, low and mid-point) calibration procedure must take place. Verify proper operation of the end device. When calibration has been verified, ensure that installation drawings, point database, and PPCL have been updated.
 - f. Set-up and or calibrate any associated equipment, (i.e., panel LCD meters, loop isolators, pneumatic gauges, etc.). Also verify that these auxiliary devices are mounted in the correct location, and are wired or piped and installed correctly per the design documentation package.
 - g. After verifying the set-up and operation of any associated equipment check for the correct operation of the logical point and associated equipment by commanding the analog output to the top and bottom of its range. Verify that the control device(s) responded appropriately as indicated by the design documentation package. Check to insure that all network terminals, host console devices, etc. can also command these outputs.
 - h. Check that all pneumatic gauges, pilot positioners and LCD panel meters indicate the correct values.
6. Terminal equipment controller checkout:
 - a. Load program database
 - b. Enable programs
 - c. Verify sequence of operations
7. Programming checkout:
 - a. Provide checkout for each system and sequence of operation.
 - b. The following are sample sequence of operations tests. The intent of these procedures is to provide a plan of action to verify system operations via block checks of the project specific sequence of operations. The procedures may be used in this format, or one procedure

to a page should more detail be required. The procedures outlined below should be verified for accuracy and may be modified to meet your specific requirements.

- c. Description of Test: AHU Alarm Checkout. Verify AHU-1 discharge air temperature alarming is operational and is received at the designated terminal.
 - d. Input to Trigger Test: Change discharge temperature high alarm limit through software to a value below the current discharge temperature (discharge temperature - 10°F).
 - e. Expected Outcome: A high temperature alarm will be received per the Alarm Definition Report at its designated terminal.
 - f. Provide signoff sheet with indication for test Pass, Fail, Date of test and Initials for signoff.
8. Workstation checkout:
- a. Verify the operation of all trunk interface equipment.
 - b. Verify all workstation software, including options, based upon the installation instructions for the PC.
 - c. Perform software backup (site, options, etc.)
 - d. Complete workstation configuration report for owner signoff.
 - e. Provide verification that all graphics have been created, as required by project bid documents.

3.83 TESTING AND ACCEPTANCE

A. General:

- 1. After completion of installation and start-up procedures, commence the specified 3-phase verification and testing sequence leading to final acceptance.
 - a. Follow in the order specified.
 - b. Each testing phase shall be satisfactorily completed before entering the next phase.
- 2. Prior to entering each phase of the sequence, submit for approval, a written agenda describing in detail the procedure to be followed to meet the requirements for each specified verification, test or demonstration.
- 3. Submit for approval, a sample of the form on which the test will be reported.
 - a. Identify project.
 - b. Provide a list of all points, arrange in numerical order of point addresses.
 - 1) Show point descriptor and location of each.
 - 2) Indicate DDC panel that processes each point.
 - 3) Use the list as a basis for the specified report form.
 - c. Signatures of participants and observers.
 - d. Results.
 - e. Description of adjustment or corrections of points in error.
 - f. Date.
- 4. Provide schedule of tests. Estimate dates of significant events.
- 5. Test, calibrate and adjust each point in the system as specified.
- 6. Provide documentation of all tests and verifications as specified.
- 7. Provide trend reports indicating proper control of all points for an extended period of time.

B. Phase 1 - Testing, Calibrating, and Adjusting:

- 1. Operate each analog point in the entire system.

- a. At a point in the upper quarter of its range.
 - b. At a point in the lower quarter of its range.
 - c. At its operating point.
 2. Provide personnel and diagnostic instruments at both the central and remote locations.
 3. Provide testing stimulants for alarms.
 4. Use digital meters of double the accuracy of the instruments being calibrated.
 5. Provide an approved test device for simulating high and low temperatures.
 6. When the function is performed, read values at the central control and observe the actual function at the field instrument.
 7. Exercise each binary point and observe indication at console and simultaneously observe operation in the field.
 8. Submit an operation report for each point in the system, in approved format, and describe any corrective or adjusting action taken.
 9. Test all power transducers with a Dranetz Power Analyzer.
- C. Phase 2 - Equipment and Point Verification:
 1. Verify calibration or function of each point.
 - a. Verify analog points at operating value.
 - b. Record on specified form.
 - c. Make approved adjustments to out of tolerance points.
 - 1) Identify these points for ready reference.
 2. After verification procedure is completed:
 - a. Verify corrected points.
 - b. Record on specified form.
 - c. Points requiring correction.
 - 1) Replace sensor or actuator if electrical measurements indicated components are out of specified tolerance.
- D. Phase 3 - Software Verification:
 1. Submit agenda and report format for software demonstrations.
 2. Demonstrate to the Owner and the Engineer that all software programs and automatic control sequences function as specified.
 3. Demonstrate compliance with response time specifications.
 - a. Simulate normal heavy load conditions.
 - b. Initiate at least ten successive occurrences on normal heavy load conditions as specified, and measure response time of typical alarms and status changes.
 04. Provide written documentation of demonstration, signed by representatives of the Contractor and Engineer.
- E. Provide the following reports to Engineer at final completion of all Testing:
 1. List of all points.
 2. List of all points currently in alarm.
 3. List of all disabled points.
 4. List of all points in over-ride status.
 5. List of all points currently locked out.
 6. List of user accounts and access levels.
 7. List all weekly schedules.
 8. List of holiday programming schedules.

9. List of limits and deadbands.
 10. System diagnostics reports including, list of DDC panels on line and communicating, status of all DDC terminal units device points.
 11. List of programs.
 12. Provide trend data reports to ensure proper operation and sequence control of BMCS.
- F. Substantial Completion of the BMCS will not occur until completion and acceptance of all testing and acceptance procedures.

3.84 TRAINING

- A. The contractor shall provide factory-trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.
- B. Provide 40 hours of training for Owner's designated operating personnel. Training shall include:
- Explanation of drawings, operations and maintenance manuals
 - Walk-through of the job to locate control components
 - Operator workstation and peripherals
 - DDC controller and ASC operation/function
 - Operator control functions including graphic generation and field panel programming
 - Operation of portable operator's terminal
 - Explanation of adjustment, calibration and replacement procedures
 - Student binder with training modules
- C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor.

3.85 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
1. Construct and maintain project schedule.
 2. Authorized to accept and execute orders or instructions from General Contractor, Owner / Architect & Engineer.
 3. Attend project meetings as necessary to avoid conflict and delays.
 4. Make necessary field decisions relating to this section.
 5. Coordination / Single point contact.
 6. Have Internet access for project management.

END OF SECTION

SECTION 232000 - HVAC PIPE AND PIPE FITTINGS – GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 23 - Mechanical.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Valves, Strainers, and Vents.
 - 2. Vibration Isolation.
 - 3. Insulation.
 - 4. Other Piping Sections.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 - 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 - 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 - 3. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.

1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe, or equipment. Align bolt holes to straddle the vertical, horizontal, or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
 2. Use flat-face companion flanges only with flat-faced fittings, valves, or equipment. Otherwise, use raised-face flanges.
 3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. Mechanical Joints: Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
 2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
 3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
 4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.

2.3 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe material of different types join use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller: For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swaged nipple may be used.
- B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

- A. High Temperature Piping: Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.

- B. Other Piping: Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

- A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.7 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.
- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.
- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.

3.2 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

- E. Remove dirt, scale, and other foreign matter from inside piping before tying into existing piping sections, fittings, valves, or equipment.
- F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings, and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging. Review structural drawings for additional information.
- B. Provide supports both sides and within 12" of each horizontal elbow for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On chilled water pipe supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section, and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion. Use hangers with 1-1/2" minimum vertical adjustment.
- F. Use electro-galvanized or zinc plated beam clamps if acceptable to the structural engineer, threaded rods, nuts, washers, and hangers. All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. Use only on beams as directed by the Structural Engineer.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Provide hangers within 3' of pipe length from all coil connections.

- I. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Ft.	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.5 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanized members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.
- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

- A. Support condensate drainpipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and antioxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors, or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.8 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.9 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16-gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and airtight. Seal annular space between pipes and sleeves with mastic compound to make the space water and airtight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate. Flush the chilled and hot water systems utilizing the filter feeders.
- B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.
- C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until “potable water clear” and particles larger than 5 microns are removed.
- D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
- E. Dispose of water in approved manner.
- F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be equal to Nalco 2578 prepping compound. Insert anti-foam compound as necessary. Circulate for 48 hours or as recommended by the manufacture. Dispose of water in approved manner. Flush system and replace with clean water. Verify compatibility of chemicals used with existing chemical treatment program on remodel projects.
- G. Phase Three: Final flushing and rinsing: Flush and rinse until “potable water clear” and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
- H. Submit status reports upon completion of each phase of work on each system.
- I. Special requirements, if any, are specified in the sections on each type of piping or in the section on Water Treatment Systems.

3.13 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.

- C. If any leaks or other defects are observed, suspend the test, and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows, and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows, and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:
 - 1. both sides of penetrations through walls, floors, and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 “Scheme for Identification of Piping Systems”.

END OF SECTION

SECTION 232113 - HOT WATER AND CHILLED WATER PIPING, VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install heating water and chilled water piping, valves, and appurtenances, including fittings and strainers. Domestic hot water piping is specified in the Domestic Water Piping and Appurtenances section.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Pipe and Pipe Fittings - General
 - 2. Valves, Strainers, and Vents
 - 3. Vibration Isolation
 - 4. Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. For pipe 2" and less in diameter, provide pipe conforming to ASTM A 53, Grade A or B, or ASTM A106 standard weight seamless, or electric resistance welded black steel pipe. Furnish 150 lb. screwed malleable iron fittings conforming to ANSI B 16.3 for chilled water. Provide fittings conforming to ANSI B 16.4 for hot water.
- B. For pipe 2-1/2" in diameter and larger, provide pipe meeting the requirements of ASTM A 53, Grade A or B, or ASTM A 106 standard weight seamless, or electric resistance welded black steel pipe with standard weight seamless steel welded fittings, satisfying ASTM A 234, Grade WPA or WPB, ANSI B16.9.

2.2 VALVES

- A. Refer to Section 23 05 23.
- B. Refer to Building Management and Control System.

2.3 WATER SPECIALTIES

- A. Pressurized Expansion Tanks shall be precharged steel tank with a replaceable heavy duty Butyl rubber bladder. The tank shall have a 1-1/2" system connection, drain, and a standard tire valve to facilitate on-site charging of the tank. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VIII of ASME Boiler and Pressure Vessel Code and stamped 125 PSI working pressure.
 - 1. Acceptable manufacturers: Bell & Gossett, Taco, Wessels, John Wood Company, and Wheatley.

- B. Air Separators shall be centrifugal type. The inlet and outlet connections shall be the same as adjoining pipe. Vessel shell diameter is to be three times the nominal inlet/outlet pipe diameter. The unit shall have an internal stainless steel air collector tube with perforations and 63% open area designed to direct accumulated air to the compression tank via a vent connection at top of unit. The air separator must be designed, constructed, and stamped for 125 psig @ 350°F in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. The air separator(s) shall be painted with one shop coat of light gray air-dry enamel. A Manufacturer's Data Report for Pressure Vessels, Form U-1 as required by the provisions of the ASME Boiler and Pressure Vessel Code shall be furnished for each air separator upon request.
1. Acceptable manufacturers: Bell & Gossett, Armstrong, Taco, John Wood Company, and Wheatley.
- B. Air and Dirt Separators shall be a full flow coalescing type combination air eliminator and dirt separator. The separator shall be designed for full flow high volume systems. The inlet and outlet connections shall be the same as adjoining pipe. Vessel shall be fabricated steel, rated for 150 psig working pressure, stamped, and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet and outlet nozzles. The vessel shall include copper or stainless-steel coalescing medium to aid in the separation of air and dirt in the system entrained water. Air elimination efficiency shall be 100% free air, 100% entrained air, and a minimum of 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. Unit shall be provided with a separate venting chamber to prevent system contaminants from harming the float and venting valve operation.
1. Acceptable manufacturer shall be Spirovent Series HV by Spirotherm, TACO High Velocity 4900, Thrush Aar-O-Vent
- C. Automatic Air vents shall be float actuated high-capacity air vent designed to purge free air from the system and provide shutoff at pressures up to 150 psig at a maximum temperature of 250 degrees F. The design of the high-capacity air vent shall prevent air from entering the system if system pressure should drop below atmospheric pressure. The high-capacity air vent shall purge free air at pressures up to 150 psig during normal system operation. The high-capacity air vent shall be constructed of cast iron and fitted with components of stainless steel, brass, and EPDM.
1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.
- D. Pressure Reducing Valves shall be diaphragm operated with brass body, low inlet pressure check valve and inlet strainer. The strainer shall be easily removed without system shutdown. The valve seat, strainer, and stem must be removable and of non-corrosive material.
1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.

PART 3 - EXECUTION

3.1 TESTING

- A. Test all piping systems to assure they are absolutely leak free.

- B. Apply a hydraulic pressure 1-1/2 times the operating pressure, 150 psig minimum, and check for leaks. Maintain test for a minimum of 24 hours. The piping system must remain absolutely tight during this period. The satisfactory completion of any test or series of tests will not relieve the contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories. The test should be observed by the Architect / Engineer before pressure is removed and water drained.

3.2 AIR HANDLING UNIT PIPING

- A. Provide a minimum of 12" of straight pipe at all coil piping connections.

3.3 AIR AND AIR/DIRT SEPARATOR

- A. Install full size drain to nearest floor drain.

END OF SECTION

SECTION 232123 - HVAC PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. General characteristics for pumps specified in Division 23 - Mechanical.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 23 - Mechanical, including the following:

- A. Division 23 Mechanical - Electrical Provisions of Mechanical Work.

1.3 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.
- J. Pumps shall be suitable for parallel operation. Where pumps are operated in parallel, individual pumps shall be capable of stable operation with only one pump operating in the system. Submit pump curves with single and multiple pumps operating on system curve for approval.

1.4 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.
- B. The head capacities indicated in the schedules are listed for bidding purposes only. Calculate the operating head at each pump; take into consideration the actual routing of the various lines, pressure drops in heat exchangers and coils, exact lengths of pipe, fittings, etc. Submit these calculations, together with copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.

1.5 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. When multiple pumps are operating in parallel, show pump curves for one pump running, two pumps running, and so on. Show pump curves with system curve plotted.

PART 2 - PRODUCTS

2.1 HORIZONTAL PUMPS

- A. Pump Construction:
 - 1. Cast iron, designed for 175 psi working pressure
 - 2. Bronze case wear rings
 - 3. Grease lubricated ball bearings selected for an average life of 200,000 hours, pressure grease fittings
 - 4. Flexible coupled
 - 5. Hot Dipped galvanized drip-rim structural steel base extending past the pump flanges allowing all condensation to be accumulated. Galvanized integral drain pan.
 - 6. Falk all-metal center dropout spacer coupling
 - 7. Totally enclosed metal or high-impact polyethylene plastic (Orange Peel) coupling guard per ANSI B15.1, Section 8 and OSHA 1910.219
 - 8. Suction and discharge flange gauge ports
 - 9. Fully enclosed bronze impeller keyed to the shaft
 - 10. 304 Stainless steel shaft minimum
- B. End suction pump volute with integrally cast pedestal support foot for back pullout to allow pump to be serviced without disturbing the system piping. Pumps utilizing pedestal mounted bearing frames in lieu of volute will not be accepted.
- C. Bearings:
 - 1. Conform to Anti-Friction Bearing Manufacturers Association (AFBMA) Standards
 - 2. Ball or roller bearing pillow block type

3. Self-aligning
 4. AFBMA L50 rating of 200,000 hours
- D. Horizontal or vertical split case pumps: Double row grease lubricated ball bearing each side.
- E. Provide each pump with an internally flushed mechanical seal. If external flush line is required, provide sediment filter for each line.
1. Use seal materials suitable for the pumped liquid
 2. Renewable bronze or stainless shaft sleeve
- F. Provide each pump with a stuffing box with packing:
1. Hardened 440C stainless steel renewable shaft sleeve
 2. Bronze gland and stainless-steel gland bolts
 3. Oil graphite packing
- G. Paint entire unit with two coats of machinery enamel after completion of installation.
- H. Pump Motor:
1. Premium efficiency
 2. Totally enclosed fan cooled
 3. Cast iron frame and end plate
 4. Forge steel lifting eye
 5. Over sized conduit box with ground lug
 6. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve
 7. Designed for Variable Frequency Drive Application
 8. Provide with factory installed shaft grounding rings by AEGIS.
 9. Minimum Efficiency

3 hp	1800 rpm	89.5%
5 hp	1800 rpm	90.2%
7.5 hp	1800 rpm	91.7%
10 hp	1800 rpm	91.7%
15 hp	1800 rpm	92.4%
20 hp	1800 rpm	93%
25 hp	1800 rpm	93.6%
30 hp	1800 rpm	94.1%
40 hp	1800 rpm	94.5%
50 hp	1800 rpm	94.5%
60 hp	1800 rpm	95%
75 hp+	1800 rpm	95.4%

- I. Data plates:
1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
 2. Locate the nameplate for easy visibility.
 3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number

- b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)
- J. The schedule on the drawing sets forth the type of pump and GPM required.
 - 1. The head capacities and horsepower are for bidding purposes only.
 - 2. Make pump selection based on actual system calculations.
- K. Acceptable manufacturers:
 - 1. Armstrong
 - 2. Amtrol/Thrush
 - 3. Bell & Gossett
 - 4. Grundfos
 - 5. TACO

2.2 VERTICAL IN-LINE (VIL) PUMPS

- A. Pump Construction:
 - 1. Pump casing, cast iron with 125 psig ANSI/PN16 flanges for working pressure below 175 psig at 150°F and ductile iron with 250 psig ANSI / PN25 flanges for working pressure to 375 psig at 150°F.
 - 2. Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.
 - 3. Impeller: Bronze, fully enclosed type; dynamically balanced, two-plan balancing is required where installed impeller diameter is less than 6 times the impeller width.
 - 4. Shaft: Provide stainless steel pump shaft.
 - 5. Coupling: Rigid spacer type of high tensile aluminum alloy. Coupling is to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor.
 - 6. Mechanical seals shall be stainless steel multi-spring inside or outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide 316 stainless steel glad plate. Provide factory installed flush line with manual vent.
 - 7. Split coupled pumps shall be provided with a lower seal chamber throttle bushing to ensure seals maintain positive cooling and lubrication.

8. Provide seal flush supply line to the mechanical seal with a 50-micron cartridge filter and sight flow indicator to suit the working pressure encountered. Filters shall be changed by the installing contractor after system is flushed and on a regular basis until turned over to the Owner.
 9. Supply in the flush line to the mechanical seal a maintenance free sediment separator with sight flow indicator.
- B. Single stage, single or double suction type, with pump characteristics which provide rising heads to shut off. Refer to pump schedule for pump flows and heads and motor speed, enclosure, efficiency and power requirements and other system conditions.
- C. Pump Motor:
1. Premium efficiency
 2. Totally enclosed fan cooled
 3. Cast iron frame and end plate
 4. Forge steel lifting eye
 5. Over sized conduit box with ground lug
 6. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve
 7. Designed for Variable Frequency Drive Application
 8. Minimum Efficiency
- | | | |
|--------|----------|-------|
| 3 hp | 1800 rpm | 89.5% |
| 5 hp | 1800 rpm | 90.2% |
| 7.5 hp | 1800 rpm | 91.7% |
| 10 hp | 1800 rpm | 91.7% |
| 15 hp | 1800 rpm | 92.4% |
| 20 hp | 1800 rpm | 93% |
| 25 hp | 1800 rpm | 93.6% |
| 30 hp | 1800 rpm | 94.1% |
| 40 hp | 1800 rpm | 94.5% |
| 50 hp | 1800 rpm | 94.5% |
| 60 hp | 1800 rpm | 95% |
| 75 hp+ | 1800 rpm | 95.4% |
- D. Data plates:
1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
 2. Locate the nameplate for easy visibility.
 3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)

- k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)
- E. The schedule on the drawing sets forth the type of pump and GPM required.
 - 1. The head capacities and horsepower are for bidding purposes only.
 - 2. Make pump selection based on actual system calculations.
- F. Acceptable manufacturers:
 - 1. Armstrong Series 4300
 - 2. Aurora
 - 3. Bell & Gossett
 - 4. Grundfos
 - 5. Patterson
 - 6. TACO

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
 - 1. Provide access space around pumps for service.
 - 2. Install pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Install stainless steel drain pan with trough under chilled water pumps only.
 - 3. Provide air cock and drain connection piped to floor drain.
 - 4. Lubricate pumps prior to start-up.
 - 5. Install condenser water pumps to ensure a full flooded suction.
 - 6. Paint entire unit with two coats of machinery enamel after completion of installation.
 - 7. Provide a spool piece between the suction diffuser and the suction side of the pump minimum length 8" face to face.
 - 8. Provide pressure taps with valves on each side of the pump.
 - 9. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge. Provide an automatic air vent off the pump casing. For base mounted pumps, provide a drain line the full size of the base connection and extend it to and terminate it over the nearest floor drain.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.

- D. Ensure pumps:
 - 1. Operate at specified system fluid temperatures without vapor binding and cavitation.
 - 2. Are non-overloading in parallel and individual operation.
 - 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.2 ALIGNMENT FOR BASE MOUNTED PUMPS

- A. Set the pump on a concrete inertia base or concrete housekeeping pad as specified; anchor, level and grout.
- B. Align the pump and driver in accordance with Hydraulic Institute Standards for centrifugal, rotary and reciprocating pumps.
- C. Realign the pump and driver after initial leveling of pump base before placing the grout and again after the grout has set and the foundation bolts are tightened. Recheck the alignment after the piping has been connected.

3.3 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
 - 1. Technicians, as required, shall be trained and experienced in the work they perform (contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
 - 1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 - 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
 - 3. Submit readings for approval.
 - 4. Include the approved readings in the Owner's Maintenance Manual.

3.4 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
 - 1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
 - 2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.
- B. Enter the information on the final configuration of the pump in the Owner's Manual.
 - 1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.5 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
 - 1. A mechanical seal for each pump
 - 2. A set of bearings for each pump

END OF SECTION

SECTION 232124 - CONDENSER WATER PIPING, VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED WORK

- A. Division 23 Mechanical
 - 1. Pipe and Pipe Fittings - General
 - 2. Valves, Strainer, and Vents
 - 3. Vibration Isolation
 - 4. Painting

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Aboveground.
 - 1. 2" or smaller diameter pipe: Provide ASTM A #53 Grade A or B or ASTM A 120, Sch. 40 seamless or electric resistance welded black steel pipe with 150 lb. screwed malleable iron fittings, ANSI B16.3.
 - 2. 2-1/2" through 6" pipe: Provide ASTM A #53 Grade A or B or ASTM A 120, Sch. 40 seamless or electric resistance welded black steel pipe with standard weight seamless steel welding fittings, ASTM A 234, Grade WPA or WPB, ANSI B16.9.
 - 3. 8" through 20" pipe: Furnish ASTM A 53, Grade A or B, Sch. 20, seamless or electric resistance welded black steel pipe with standard weight seamless steel welding fittings, ASTM A 234, Grade WPA or WPB, ANSI B16.9.
 - 4. 24" and larger diameter pipe: ASTM A 53, Grade A or B, 0.375" wall seamless or electric resistance welded black steel pipe with seamless steel welding fittings, 0.375" wall, ASTM A 234, Grade WPA or WPB, ANSI B16.9. At Contractor's option, pipe sizes over 24" outside diameter can be ASTM A 134 with mitered fittings using ASTM A 285, Grade B or C steel plate.
- B. Exterior Above Grade:
 - 1. Galvanized steel pipe, Schedule 40
 - 2. Fitting: Grooved
- C. Underground: Same as above except provide corrosion protection as specified in Section 23 20 02.

2.2 VALVES

- A. Refer to Section 23 05 23.
- B. Refer to Building Management and Control System.

PART 3 - EXECUTION

3.1 TESTING

- A. Apply a hydraulic pressure of 1-1/2 times operating pressure, 150 psig minimum, and check for leaks. Maintain test for a minimum of 24 hours. The piping system must remain absolutely tight during this period. The satisfactory completion of any test or series of tests will not relieve the contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories. The test should be observed by the Architect / Engineer before pressure is removed and the water drained.

END OF SECTION

SECTION 232300 - REFRIGERANT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install copper tubing, valves, strainers and sight glass for refrigerant piping.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Pipe and Pipe Fittings
 - 2. Piping Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Furnish refrigerant piping of Type K hard-drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

2.2 SERVICE VALVES

- A. Provide angle or globe service valves, with sweat connections. Use packed-type, wrench operated, valves with gasketed seal cap and back seat feature. Furnish valves designed for refrigerant service, in conformance with the ARI code.
- B. Place service valves at the inlet and outlet of each compressor, on both sides of each strainer and solenoid valve, and as otherwise shown and specified.

2.3 SOLENOID VALVES

- A. Furnish pilot-operated, floating-piston solenoid valves suitable for operation with refrigerant.
- B. Use valves with a bronze body and sweat-type connections.
- C. Provide stainless steel stem and plunger assembly and a stainless steel piston.
- D. Furnish sealed and moisture proof solenoid coils.
- E. Use electrical characteristics of 115 volt, 60 Hertz.

2.4 SIGHT GLASSES

- A. Provide suitable moisture and liquid sight glass in the liquid line leaving the condenser or receiver.

2.5 FILTER DRYER

- A. Furnish replaceable core liquid line filter dryer.
- B. Provide filter dryer constructed to permit the removal of the core element without removing the filter dryer from the line.

PART 3 - EXECUTION

3.1 BRAZING

- A. During the brazing process, dry nitrogen shall be purged through the tubing to prevent oxides from forming.

3.2 PRESSURE TEST

- A. After refrigeration and piping system items are installed, charge the system with dry nitrogen and test to 450 psig.
 - 1. Test joints with a Halide torch or an electronic leak detector.
 - 2. Repair leaks and retest each system until proved tight.

3.3 EVACUATION AND DRYING

- A. After refrigerant system has been pressure-tested, connect a suitable vacuum pump and evacuate piping system, including lines and equipment.
 - 1. Maintain a vacuum as high as practicable for long enough to evaporate the moisture in the system (at least 48 hours).
 - 2. Check the humidity within the system with a wet bulb indicator, and maintain the vacuum until the wet bulb temperature is reduced to -40°F. After the system has been evacuated and dried, break the vacuum by charging proper refrigerant into the system.

3.4 PIPE SIZE

- A. Pipe shall be routed and sized per condensing unit manufacturer's instructions.

END OF SECTION

SECTION 233113 – DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Duct construction, support and accessories. Dimensions shown on the drawings are free area dimensions.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Air Devices
 - 2. Air Handling Units
 - 3. Insulation
 - 4. Terminal Units
 - 5. Fan Coil Units
 - 6. Fans
 - 7. Packaged Rooftop Air Conditioners
 - 8. Testing, Balancing and Adjusting (TAB) of Environmental Systems
- B. Division 9 – Finishes, Painting and Color Coding

1.3 QUALITY ASSURANCE

- A. The intent of ductwork specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide ductwork in accordance with the specifications for each type of service.
- B. An approved contractor for this work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 5 systems of comparable size and type that have served their owners satisfactorily for not less than 5 years.

1.4 GUARANTEE

- A. Guarantee ductwork for 1 year from the date of substantial completion. The guarantee covers workmanship, noise, chatter, whistling, or vibration. Ductwork shall be free from pulsation under conditions of operation.

1.5 CONTRACTOR COORDINATION

- A. Erect ducts in the general locations shown but conform to structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.

- B. Coordinate location of ductwork with structural members and Architectural drawings and requirements.

1.6 SHOP DRAWINGS AND SAMPLES

- A. Submit shop drawings of all ductwork layouts, including enlarged plans and elevations of all air handling equipment, and submit details of duct fittings, including particulars such as gauge sizes, welds, and configurations prior to starting work.
- B. Submit product data and sealing materials to be used.
- C. Submit sound attenuation data.
- D. Submit shop drawings in plan, elevation and sections, and three-dimensional view showing equipment in mechanical equipment areas.

PART 2 - PRODUCTS

2.1 STANDARDS AND CODES

- A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards. Air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and NFPA 90A.

2.2 DUCT MATERIAL AND CONSTRUCTION

- A. Except for the special ducts specified below use lock forming quality prime galvanized steel sheets or coils up to 60" wide. Stencil each sheet with gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10' centers with gauge and manufacturer's name. Provide certification of duct gauge and manufacturer for each size duct.
- B. Rectangular low and medium pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.
- C. Low pressure round ducts shall be shop fabricated with snap lock longitudinal seams. Ducts shall be constructed for a minimum of 2" w.g. static pressure.
- E. Dishwasher Hood Exhaust System: Welded 304 Stainless steel.
- F. Shower Area Exhaust Systems: Welded 304 Stainless steel.
- G. Kitchen exhaust duct: Welded Black steel, minimum 16 gauge

2.3 ACOUSTICAL DUCT

- A. Duct and fittings:
 - 1. Double wall acoustically treated.
 - 2. Annular space packed with fiberglass insulation.
 - 3. Perforated metal liner to provide specific acoustic impedance

4. Insulation 1.0 pcf. 1 inch thick
5. United McGill Acousti-K27 spiral lockseam or approved equal
6. Material as indicated below:
 - a. Paintable Galvanized Steel
 - b. Stainless Steel
 - c. Aluminum

B. Pressure rating and tests as specified for single wall ductwork.

2.4 DUCT SEALING OF SEAMS AND JOINTS

- A. Follow seal classification as indicated in Table 1-2 of SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL". Use seal class A for 4" w.g. static. All longitudinal and transverse joints and seams shall be sealed by use of a fireproof, non-hardening, and non-migrating elastomeric sealant. With the exception of continuously welded joints and machine-made spiral lock seams, joints and seams made airtight with duct sealer.
1. Indoor applications – Foster 32-14
 2. Outdoor applications – Foster 32-17

2.5 FLEXIBLE DUCT LOW PRESSURE

- A. Construction:
1. Continuous galvanized spring steel wire helix, with reinforced metalized cover
 - a. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
 2. UL 181 Class I air duct label
 3. Reinforced vapor barrier jacket
 4. Rated for use at system pressure (6" wc minimum)
 5. Flexible duct connections from lateral taps to variable volume boxes or terminal boxes shall be rated at twice the maximum pressure rating of the medium pressure system.
- B. Fire hazard classification:
1. Flame spread rating 25 maximum.
 2. Smoke developed rating 50 maximum.
- C. Thermal characteristics:
1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
 2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
 3. 2" minimum wall thickness insulation with 1" overlap
- D. Acceptable manufacturers:
1. Flexmaster
 2. Hart & Cooley
 3. Omniair
 4. Peppertree Air Solutions

2.7 DUCT BOARD

- A. Construction:

1. Rigid, resin bonded fibrous glass board with damage-resistant, flame retardant, reinforced aluminum foil (FRK) facing.
 - a. Pressure Sensitive Tape listed and labeled under UL 181A, Part I(P). All longitudinal and circumferential joints stapled with outward flaring 2-1/2" staples, 2" on center. Coat all joins and seams with duct closure mastic. Foster 95-90 / 95-96. Mastic shall meet UL 181A-M and UL 181B-M.
 2. UL 181 Class I air duct label
 3. Provide mat air stream surface to isolate glass fiber substrate from air stream and inhibit penetration by dirt, dust and other pollutants. Air stream surface shall include an EPA registered biocide to protect air stream surface from microbial growth and meet requirements of ASTM C 138, ASTM G 21 and ASTM G 22.
 4. Operating static pressure to +/- 2 inches water gauge, internal air temperatures 40 degrees F to 250 degrees F and air velocities up to 6,000 feet per minute.
- B. Fire Hazard classification:
1. Flame spread rating 5 maximum
 2. Smoke developed rating 50 maximum
- C. Thermal characteristics:
1. R-6 BTU/hr/sp. Ft./°F
 2. 1-1/2" thick
- D. Acceptable Manufacturers:
1. Owens Corning

2.8 FIRE DAMPERS

- A. Fire dampers for required wall ratings that are 95% minimum free area. Provide Type B or Type C UL dampers for low, medium and high-pressure rectangular, square or round ducts. Dampers shall be activated by a fusible link designed to react at 165°F. Install per manufactures recommendations to provide a UL assembly. Provide sealed sleeve to meet desired leakage performance.
- B. Acceptable Manufacturers:
1. Ruskin
 2. Prefco Products
 3. Air Balance
 4. Greenheck, Inc.
 5. Nailor Industries
 6. Pottoroff

2.10 WALL LOUVERS

- A. Refer to schedule on drawings. Coordinate with Architectural Drawings.
- B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.
- C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.

D. Louvers shall be AMCA-550 tested and approved.

E. Acceptable manufacturers:

1. American Warming and Ventilation
2. Arrow
3. Greenheck
4. NCA
5. Pottorff
6. Ruskin

2.13 FLUES FOR POWER EXHAUST AND HIGH EFFICIENCY BOILERS AND WATER HEATERS

A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 550°F maximum flue gas temperature and with a UL tested pressure rating of 40 inches w.c. The interior pipe shall be constructed of AL 29-4C stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one inch air gap between inner liner and outer cover. Chimney shall be constructed and installed per UL-1738 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.16 DUCT LINING

A. Duct lining shall be 1" thick, 1-1/2 lb. density, flexible lining coated on the air stream side to reduce attrition. Liner shall be Schuler Lina-Coustic, Certain-Teed Ultralite, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

2.18 VOLUME DAMPERS

A. Manual balancing dampers that meet or exceed the following minimum construction standards:

1. Frame 16-gauge
2. Blades 16-gauge
3. Bearings corrosion resistant
4. Concealed linkage
5. Opposed blade dampers

B. Acceptable manufacturer:

1. Ruskin Model MD-35 or approved equal, by
2. Arrow
3. American Warming and Ventilating
4. Nailor Industries
5. Pottorff

2.19 ACCESS DOORS

A. Round spin-in door of galvanized steel.

1. Fire proof sealing gaskets and quick fastening locking devices

2. Insulated door
 3. Conform to the requirements of the NFPA
 4. Identification and use of each access door
 5. UL label to match the construction in which it is installed
 6. Cable attached to door and outer frame
 7. Low leakage Access Door
- B. Acceptable Manufacturer
1. Flex master, Inspector Series
 2. Approved Equal

2.22 DIFFUSER FITTINGS LOW PRESSURE TAPS

- A. Fitting shall meet or exceed the following minimum construction standards:
1. Conical with a base diameter two inches larger than the tap diameter.
 2. Construct fitting and damper of galvanized steel in accordance with ASTM A 527, G90 finish.
 - a. Fitting with a 3/16-inch high stop bead approximately 2-1/2-inches from the discharge end of the fitting
 - b. Provide the fitting with a butterfly damper, damper rod, end bearings and heavy duty locking quadrant.
 - c. Size the length of the straight section of the fitting to match the damper blade diameter. Center the damper blade in the straight section.
 3. Match the fitting body gauge to the SMACNA duct gauge, but not less than:
 - a. Through 8 inches: 26 gauge; Damper blade 22 gauge
 - b. 10 inches and 12 inches: 24 gauge; Damper blade 22 gauge
 - c. 14 inches and 16 inches: 22 gauge; Damper blade 22 gauge
 - d. 18 inches and 20 inches: 20 gauge; Damper blade 20 gauge
 4. Fasten damper blade to a 3/8 X 3/8 continuous square rod with minimum (2) galvanized U-bolts.
 5. Support the damper rod to the fitting with airtight nylon end bushings / bearings.
 6. Provide the damper with a self-locking regulator and handle.
 7. Provide a 2" sheet metal stand-off to extend the regulator.
 8. Flex duct grip area – 2 inches behind retaining bead
 9. Flex duct retaining bead – 1 inch from end
 10. Conical length of at least 3 inches
 11. Barrel length of at least 9 inches

2.23 AUXILIARY DRAIN PANS

- A. Galvanized steel, same gauge and same bracing or cross breaks as a duct with same dimensions. Sides of pan turned up to 1-1/2", all joints soldered watertight. Pan is to be large enough to complete cover drip lines of unit.

2.24 DUCTWORK SUPPORTS ON ROOF

- A. Support ductwork on roof with Portable Pipe Hanger Model PHP-D fully adjustable height and width. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized framing. Nuts and washers shall be hot dip galvanized.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use construction methods and requirements as outlined in SMACNA HVAC Duct Construction Standards as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in the specifications. Refer to details on the drawings for additional information.
- B. Reinforce ducts in accordance with recommended construction practice of SMACNA. Provide additional reinforcement of large plenums as required to prevent excessive flexing and or vibration.
- C. Cross break or bead sheet metal for rigidity, except ducts that are 12" or less in the longest dimension.
- D. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers.
- E. At locations where ductwork passes through floors, provide watertight concrete curb around penetration.
- F. Support ducts where passing through floors with galvanized steel structural angles of adequate bearing surface.
- G. Metal or lined ductwork exposed to view through grilles, registers, and other openings shall be painted flat black. Do not install grilles, registers, or similar items until painting is complete.
- H. Fire Dampers shall be installed per manufacturer's recommendations to create a UL rated assembly.
- I. Install end bearing at all location where damper shaft penetrates duct wall.
- J. Clean duct to remove accumulated dust. Ducts shall be closed on ends between phases of fabrication to assure that no foreign material enters the ducts.

3.2 DUCTWORK

- A. Construct rectangular ducts and round ducts in accordance with the latest SMACNA HVAC Duct Construction Standards. Use the static pressure specified on the air handling unit schedule or fan schedules as a minimum for duct construction. All ductwork between the variable volume air handling units and the terminal units shall be constructed to the medium pressure ductwork specification.
- B. Provide adjustable, galvanized splitter-dampers, pivoted at the downstream end with appropriate control device at each supply duct split.
- C. For branch ducts wider than 18", and when shown on drawings provide extractors with an appropriate control device at each rectangular zone or branch supply duct connection. Provide controllers for extractors. Branch ducts shall have a 45° angle in the direction of

flow. Do not provide extractor at branch ducts to sidewall registers where the registers are within 10 feet of the main duct.

- D. Shop manufactured curved blade scoops may be used for branch duct takeoffs up to 18" wide. Taper scoop blade to the end, to prevent any sagging that may cut into, or damage duct liner if specified during operation.
 - 1. Construct shop manufactured scoops and splitter blades of galvanized sheet metal 2 full gauges heavier than equivalent sheet metal gauge of branch duct (up to 16 gauge).
 - 2. Check extractors, scoops and splitter blades thoroughly for freedom of operation. Oil bearing points before installing.
- E. Use pushrod operator with locking nut and butt hinges assembly.
- F. Provide opposed-blade volume dampers with an appropriate control device in each of the following locations:
 - 1. Return air ductwork
 - 2. Outside air branch duct
 - 3. Exhaust branch duct
 - 4. Exhaust connections to hoods except kitchen grease hoods or equipment
 - 5. In each zone at multi-zone unit discharge installed downstream of duct mounted re-heat coils
 - 6. At each outside air and return air duct connection to plenum of constant volume units
 - 7. At discharge side of constant volume boxes
 - 8. Where otherwise indicated or required for balancing coordinate location of additional dampers required by TAB Contractor.
 - 9. Provide multi-blade dampers when blade width exceeds 12". Provide end bearing where damper shaft penetrates duct wall.
- G. Elbows:
 - 1. Rectangular: Where square elbows are shown, or are required for good airflow, provide and install single-wall or airfoil turning vanes. Job-fabricated turning vanes, if used, shall be single-thickness vanes of galvanized steel sheets of the same gauge metal as the duct in which they are installed. Furnish vanes fabricated for the same angle as the duct offset. The use of radius elbows with a centerline radius of not less than 1-1/2 times the duct width may be provided in lieu of vaned elbows where space and air flow requirements permit.
 - 2. Round Oval Duct. Provide elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5 piece, 90° elbows and 3 piece, 45° elbows.
- H. For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed-type Young regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. Provide with chrome plated cover plates. Use only one mitered gear set for each control device.
- I. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.

J. Insulated Flexible Duct:

1. Install in accordance with manufacturer's instructions, and the terms of its UL listing. Duct shall not exceed 6' in length. Make connections by use of sheet metal collars and stainless steel circular screw clamps. Clamps shall encircle the duct completely and be tightened with a worm gear operator to the point that will provide an airtight connection without unnecessary deformation of the duct. Provide one clamp on flexible duct and one clamp on external insulation. Vapor barrier jacket shall be tucked inside to conceal insulation material.
2. Construct bends over 45° with sheet metal elbows.

K. Duct Supports:

1. Horizontal ducts up to 40". Support horizontal ducts up to and including 40" in their greater dimension by means of #18 U.S. gauge galvanized iron strap hangers attached to the ducts by a minimum of two locations per side by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on at least 8' centers. Use clamps to fasten hangers to reinforcing on sealed ducts.
2. Horizontal ducts larger than 40". Support horizontal ducts larger than 40" in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on at least 8' centers in accordance with SMACNA Standards.
3. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles shall be increased in strength and sized on an individual basis considering space requirements.
4. Supports shall be suspended from structural or by independent support. Do not support from structural bridging. Upper attachments should be selected with a safety factor of 4 or 5 times actual load conditions and subject to Engineers approval. Double wrap straps over open web of joist.

- L. Branch connections for medium pressure ductwork shall be made with a conical lateral. Field installed conical branch ducts shall be minimum 20-gauge galvanized sheet metal, "Everdur" welded and coated with "Galvabar".

3.3 PLENUMS

- A. Return air plenums shall be rectangular galvanized sheet metal ductwork.
- B. Fabricate plenums upstream of fan of 16-gauge material.
- C. Fabricate plenums upstream of filters minimum 18-gauge material.

3.4 FLEXIBLE CONNECTIONS

- A. Where ducts connect to fans or air handling units that are not internally isolated, make flexible airtight connections using "Ventglas" fabric. The fabric shall be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Provide a minimum of 1/2" slack in the connections, and a minimum of 2-1/2" distance between the edges of the ducts. Also, provide a minimum of 1" slack for each inch of static pressure on the fan system. Fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands. Where connections are made in outdoor locations, seal fabric to metal with mastic.

3.5 ACCESS DOORS

- A. Install ductwork access doors as noted below, arranged for convenient access. Stencil each door for specific use. Install access doors in each of the following locations: *Some clients want doors on both sides of dampers.
 - 1. Fire Dampers
 - 2. Smoke Dampers
 - 3. Smoke/fire Dampers
 - 4. Outside Air Dampers
 - 5. Duct Mounted Coils (up-stream)
 - 6. Control Dampers
 - 7. 12"x12" access door for cleaning at a maximum distance of 20'-0" from center of adjacent access door. CY-FAIR REQUIREMENT
- B. Size access door 1" smaller than ductwork.
 - 1. Available Sizes: 8", 10", 12", 18", 24"
- C. Construct access door air tight, and conform to recommendations of NFPA and SMACNA.
- D. Demonstrate suitability of access for the intended purpose. Install multiple access doors as required.

3.6 DUCT LINING

- A. Install glass fiber acoustical lining where shown on drawings. Secure to duct surfaces with Foster 85-62 / 85-60 or Childers CP-125-1 / CP-127 adhesive and sheet metal fasteners on 12" centers. Coat exposed edges and leading edges of cross-joints with adhesive.
- B. Provide metal nosing that is either channeled or "Z" profiled or are integrally-formed from the duct wall securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.
- C. Refer to Insulation & Liner Detail on drawings for locations requiring liner to be installed.
- D. Do not install liner in multi-zone unit ductwork.

3.7 SEALING OF SEAMS AND JOINTS

- A. Seal supply, return, exhaust and outside air duct systems.

3.8 FLUES

- A. Provide and install flues for all gas fired equipment.
- B. Refer to plans for all related locations.
- C. Contractor is responsible for coordinating stack sizing, stack drains, stack test ports, stack termination fittings and all other required fittings with the selected equipment

manufacturers.

D. All fittings and accessories shall be manufactured by the flue manufacturer. The flue shall be installed per manufacturer's instruction.

E. Terminate flues at height above roof to prevent flue gas from entering the building.

3.9 DISHWASHER HOOD EXHAUST SYSTEM

A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot to drain toward the washer.

3.10 SHOWER AREA EXHAUST SYSTEM

A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot slope down to grille connection. Install in accordance with Fig. 2-21 of SMACNA HVAC Duct Construction Standards.

3.11 KITCHEN EXHAUST DUCT

A. All material and fittings shall be minimum 16 gauge, coated black steel to prevent rusting. All seams and joints in the kitchen exhaust duct, and penetrations of the hood enclosure to its lower outermost perimeter that directs and captures grease-laden vapors and exhaust gases shall have a liquid tight continuous external weld. All ducts shall be installed without forming dips or traps that might collect residues. Provide 18" x 18" or equal area at each elbow and as required for cleaning access, in direction of air flow. UL Listed access panel shall be located on the vertical wall of the duct 1-1/2" from the bottom of duct and shall be fitted with two handles, grease and air tight fitting access door and latch. All interior surfaces of ducts shall be accessible for cleaning and inspection purposes. Duct shall maintain minimum 1/4" per lineal foot slope to the exhaust hood. Provide duct over lay at the roof curb for a complete seal. Install kitchen exhaust system per local authority. In the absence of a local authority, the requirements of the Uniform Mechanical Code and NFPA 96 shall govern.

3.12 FUME HOOD EXHAUST SYSTEM

A. All material and fittings shall be 304 stainless steel construction.

3.13 ACOUSTICAL DUCT

A. Install in the following locations:

1. Gymnasiums
2. Auditorium
3. And/or where indicated on the drawings

3.14 SCREENS

A. Furnish and install screens on all duct, fan, etc., openings furnished by the Contractor that lead to, or are, outdoors; screens shall be No. 16 gauge, one-half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no

ductwork is connected.

3.15 CONNECTIONS TO LOUVERS

- A. Make watertight connections to all louvers. Ductwork behind louver shall have watertight soldered joints for a minimum of three feet and be sloped to bottom of louver. Lap duct to be over bottom louver blade where possible.
- B. Where plenums are installed on inside of louver, construct such that bottom of plenum will lap over bottom blade of louver to drain any water that may enter.

3.16 PLENUMS

- A. Construct plenums with galvanized steel framing members and galvanized sheet steel, cross braced and rigidly braced with galvanized angles. Gauges and bracing shall conform to SMACNA recommendations for ductwork of like sizes. Openings for fans, access doors, etc., shall be framed with galvanized steel angles.
- B. Provide access doors.

3.17 AUXILIARY DRAIN PANS

- A. Where coils that have a condensate drain are located above ceiling.

3.18 TESTING OF LOW PRESSURE DUCTWORK

- A. Test ductwork for leaks before concealing. Maximum allowable leakage is 5% of total airflow.
- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers and pressure vs CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.
- C. Mains: Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Provide pressure in mains at 1-1/2 times design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.
- D. Ductwork down stream of terminal boxes, return, exhaust, and outside air ducts are to be visually inspected.

3.19 TESTING OF MEDIUM AND HIGH PRESSURE DUCT

- A. As the project progresses, test the ductwork in sections.
- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers, and pressure vs. CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.

- C. Finally as a complete system, test ductwork at a minimum of 2.5” with a maximum allowable leakage of 1% of the total design supply airflow.
- D. Test method as set forth in SMACNA "HVAC Duct Construction Standards".

END OF SECTION

SECTION 233114 - FABRIC AIR DISPERSION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of non-metal ductwork is indicated on drawings and by requirements of this section.

1.2 QUALITY ASSURANCE

- A. Building Codes and Standards:
 - 1. Product must be Classified by Underwriter's Laboratories in accordance with the 25/50 flame spread/smoke developed requirements of MFPA 90-A and are also classified in accordance with ICC Evaluation Service AC 167.
 - 2. All product sections must be labeled with the logo and classification marking of Underwriter's Laboratories.
 - 3. Product must be treated with an EPA registered antimicrobial agent.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.
- B. Building Code Data: Submit UL file number under which product is Classified by Underwriter's Laboratories for both NFPA 90-A and ICC AC167.
- C. Submit manufacturer's documented design support information including duct sizing, vent and orifice location, vent and orifice sizing, length, and suspension. Submit parameters for design, including maximum air temperature, velocity, pressure and fabric permeability.
- D. Color selections
- E. Manufacturer's recommended suspension system

1.4 WARRANTY

- A. Manufacturer must provide a 10 Year Product Warranty for products supplied for the fabric portion of this system as well as a Design and Performance Warranty.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect fabric air dispersion systems from damage during shipping, storage and handling.
- B. Where possible, store products inside and protect from weather. Where necessary to store outside, store above grade and enclose with a vented waterproof wrapping.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, choose one of the following:

- A. DuctSox Corporation
- B. Fabric-Air
- C. KE Fibertec
- D. Prihoda

2.2 FABRIC AIR DISPERSION SYSTEM

- A. Air diffusers shall be constructed of a woven fire retardant fabric complying with the following physical characteristics:
 - 1. Fabric Construction: 100% Flame Retardant and treated with a machine washable anti-microbial agent from the manufacturer.
 - 2. Weight: 6.75 oz./yd² per ASTM D3776
 - 3. Fabric Porosity: 1.5 (+2/-1) cfm/ft² per ASTM D737, Frazier
 - 4. Temperature Range: 0 degrees F to 180 degrees F
 - 5. Fire Retardancy: Classified by Underwriters Laboratories in accordance with the flame spread/smoke developed requirements of NFPA 90-A and ICC AC 167.
 - 6. Antimicrobial agent shall be proven 99% effective after 10 laundry cycles per AATCC Test Method 100.
- B. Systems Fabrication Requirements:
 - 1. Air dispersion and extended throws accomplished by reinforced orifices and permeable fabric. Reinforced orifices are to be installed to deep the integrity of opening and withstand laundry processes.
 - 2. Diameter, quantity, and location of reinforced orifices to be specified and approved by manufacturer.
 - 3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener – supplied by contractor.
 - 4. Inlet connection includes zipper for easy removal/maintenance.
 - 5. Lengths to include required zippers as specified by manufacturer.
 - 6. System to include adjustable flow devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
 - 7. End cap includes zipper for easy maintenance.
 - 8. Fabric system shall include connectors to accommodate suspension system listed below.
 - 9. Any deviation from a straight run shall be made using a gored elbow or an efficiency tee. Normal 90 degree elbows to be 5 gores with the radius of the elbow 1.5 times the diameter.
- C. Systems Design Parameters:

1. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.
 2. Do not use fabric diffusers in concealed locations.
 3. Fabric diffusers shall be designed from 0.25" water gauge minimum to 3.0" maximum, with 0.5" as the standard.
 4. Fabric air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
 5. Design CFM, static pressure and diffuser length shall be designed or approved by the manufacturer.
- D. Fabric Tensioning System:
1. Air diffusers shall be constructed with internal tensioning frame.
 2. System shall cylindrically tension textile along the entire length of textile duct.
 3. Tensioning system shall include full 360 degree tensioning and intermediate rings with quick connection spacer tubes concealed inside the fabric system.
 4. Interior structure to include multiple mechanically adjustable tension devices. To provide proper textile tensioning, structural and textile system shall be configured in segments of no more than 45 feet.
 5. Textile components supported solely by cylindrical metal rings.
 6. Each cylindrical ring shall require vertical metal to metal vertical cable safety attachment.
 7. Component options include:
 - a. Stainless Steel Cable
 - b. Adjustable Gripple Mid-Supports – incremental lengths of 5', 10', 15', 20' and 30'

PART 3 - INSTALLATION

3.1 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM

- A. Install approved suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

3.2 CLEANING AND PROTECTION

- A. Clean air handling unit and ductwork prior to installation of the fabric duct system. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
- B. Temporary closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
- C. If fabric duct systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION

SECTION 233416 – FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install fans, including centrifugal, axial and propeller types, with supplemental equipment.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Ductwork
 - 2. Vibration Isolation
 - 3. Air Balance
 - 4. Electrical Provisions of Mechanical Work

1.3 PERFORMANCE

- A. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings. Provide fans capable of accommodating static pressure variations of +10% of scheduled design at the design air flow.
- B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA Standards. All fans provided must be licensed to bear the Certified Ratings Seal.
- C. Statically and dynamically balance all fans.
- D. Motors shall be sized so that they do not operate within the motor service factor.
- E. Fans shall be capable of 120% of the scheduled air capacities.
- F. All static pressures shown on schedules are external to fans. Manufacturer shall add damper and accessory losses to scheduled value before selecting fan.

1.4 SUBMITTALS

- A. Submit fan performance curves with system operating point plotted on curves.
- B. Submit manufacturer's printed installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Cook

- B. Greenheck
- C. Penn Barry Ventilator
- D. Twin City Fans

2.2 PROTECTIVE COATINGS

- A. Manufacturer's Standard. Apply to fans, motors and accessories, the manufacturer's standard prime coat and finish, except on aluminum surfaces or where special coatings are required.
- B. Galvanizing. After fabrication of the parts, hot-dip coat surfaces that require galvanizing. Where galvanizing is specified, a zinc coating may be used. After fabrication, apply the zinc coating and air-dry the coating to 95% pure zinc. Acceptable zinc coatings include Zincilate, Sealube, Amercoat, Diametcoat, or an approved equal.

2.3 SUPPLEMENTAL EQUIPMENT

- A. Motor Covers. Provide weatherproof motor covers for installations out of doors. Apply the same finish as used on the fan.
- B. Belt Drives:
 - 1. Unless otherwise specified for belt-driven fans, equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20% speed variation from full open to full closed. Size drives for 150% of rated horsepower. Key the fan sheave to the fan shaft.
 - 2. Nonadjustable motor sheaves may be used for motor sizes over 15 horsepower, at the Contractor's option. However, if changing a nonadjustable sheave becomes necessary to produce the specified capacity, the change must be made at no additional cost.
 - 3. Provide belt guards and apply the same finish as used on the fan.
 - 4. Oil and heat resistant, nonstatic type belts.
 - 5. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty, regreasable, ball type, in a pillow block, cast iron housing, selected for a minimum L50 life in excess of 200,000 hours at maximum catalog operating speed.
- C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.
- D. Relief Vents and Air Inlets: Provide vents and inlets with aluminum frames and 1/2" mesh, galvanized bird screens. Include dampers where shown.
- E. Prefabricated Roof Curbs: Furnish prefabricated roof curbs as detailed. The minimum height is 14". Include a resilient pad on each roof curb so the equipment can be mounted on the top flange for proper seal. Coordinate roof slope and curb to ensure equipment is installed in level position. Provide double shell to protect insulation from damage.

- F. Dampers. Where automatic backdraft damper is scheduled:
 - 1. Multi-bladed.
 - 2. Heavy duty.
 - 3. Roll formed aluminum blades.
 - 4. Nylon bearings.
 - 5. Neoprene weather strip on blade edge.
- G. Where motorized damper is scheduled:
 - 1. The motor and damper are specified in the Building Management and Control System Specification.
- H. All fans are to be provided with a durable, deep etched, .025" thick, factory installed aluminum identification plate with the following information. Plates are to be furnished with four mounting holes.
 - 1. Fan mark as indicated on the Contract Drawings.
 - 2. Serial number
 - 3. Model number
 - 4. Capacity (CFM) and static pressure.
 - 5. Motor HP
 - 6. Motor Amps
 - 7. Manufacturer
 - 8. Motor phase
 - 9. Number of Belts/Make/Size
 - 10. Motor volts

2.4 VENTILATION AND EXHAUST FANS

- A. Provide the ventilation and exhaust fans shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Provide each belt driven fan with approved, totally enclosed belt guard.
- D. Provide approved safety screen where inlet or outlet is exposed.
- E. Provide duct flanges where required for connections.
- F. Furnish kitchen hood exhaust fans with vented curb extension that meets NFPA 96, cleanout port, grease tap, curb seal, drain connection and hinge kit.
- G. Furnish supply fans with 1" aluminum, washable filter section.

2.5 ROOFTOP VENTILATION AND EXHAUST SYSTEMS

- A. Provide the rooftop ventilation and exhaust systems shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Components:
 - 1. Aluminum, stainless steel or plastic-coated bird guard.

- 2. Screws and fasteners of stainless steel or nonferrous material.
- 3. All aluminum construction unless indicated otherwise on fan schedule.
- D. Welded construction, corrosion resistant fasteners, minimum 16-gauge marine allow aluminum.
- E. Aluminum base shall be continuously welded curb cap corners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings. Ensure fan location is installed at minimum distance from roof edge to meet code requirements.
- B. Do not operate fans or fan powered devices for any purpose until ductwork is clean, filters in place, bearings lubricated, and the fan has been run under observation.
- C. Roof mounted fans and gravity roof-top intake and relief vents shall be secured to the curb with stainless steel lag screws at a minimum of 6-inches on center. Follow manufacturer's installation instructions if they are more stringent. Install roof mounted equipment in a level position. Units shall be seated on properly sized curb. Gap between base of the fan and top of the curb shall be sealed with neoprene 1" x 1/4" gasket. Gasket shall be glued or attached with pressure sensitive adhesive.
- D. Install curbs and equipment in level position.

3.2 EXTRA MATERIALS

- A. Provide two sets of belts for each fan, not including the set installed on the fans. Tag set to identify fan.

END OF SECTION

SECTION 233713 - AIR DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air distribution devices, including grilles, diffusers, registers, dampers, and extractors.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork.
 - 2. Air Balance.
 - 3. Electrical Requirements for Mechanical Work.

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.4 SUBMITTALS

- A. Submit product data for outlets, grilles, registers, control devices, and similar equipment for review prior to placement of purchase order.
- B. Submittal shall include performance sheet for each air device type. Performance sheet shall include NC levels, throw, and total pressure loss at various air flows.

1.5 FINISHES

- A. Paint exposed devices with factory standard prime coat, or factory finish coat, as specified.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES AND REGISTERS - Refer to Drawing Schedule.

2.2 ACCEPTABLE MANUFACTURERS

- A. Titus.
- B. Krueger.
- C. Nailor Industries.
- D. Price
- E. Metal-Aire

2.3 ACCESSORIES

- A. Supply Grille Extractors. Provide supply grilles with an air control device capable of positively regulating the volume of air extracted from the supply duct.

Select extractors similar to Titus Model AG25, tight closing in the minimum position. Include a key-operated or worm-gear adjusting mechanism to facilitate positioning from the grille opening. Where adjustment is not accessible at the grille opening, provide a square control rod equipped with a locking quadrant.

- B. Mounting Frames. Provide each grille or register not equipped with a removable core with a companion, all-purpose mounting frame constructed like grille frame to facilitate installation and removal of the grille or register without marring adjacent mounting surfaces.
1. Furnish frames with 1/2" thick sponge rubber gasket to prevent air leakage.
 2. Provide a frame that neatly fits the grille. Mounting frames will not be required for grilles or registers mounted directly on exposed ductwork.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Do not install ceilings adjacent to fixtures until installation of fixtures, air supply assemblies, return-air blank-off strips and flexible duct have been approved. Remove and reinstall any part of the installation found incorrect.

3.2 INSTALLATION

- A. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets to ductwork with sheet metal screws. For perforated diffusers, attach the frame assembly by a concealed hinge assembly to an outer frame compatible with the type of ceiling on which the diffuser is installed.

END OF SECTION

SECTION 235235 - GAS-FIRED MODULATING HOT WATER BOILER (Condensing)

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section specifies a packaged, gas-fired, power type condensing stainless steel boiler complete with all controls and trim for indoor installation.
- B. Each factory "packaged" boiler shall be complete with all components, accessories, and appurtenances necessary for a complete and operable boiler as hereinafter specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.
- C. Each factory "packaged" boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all be assembled and furnished by the boiler manufacturer. The boiler manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory "packaged" boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

1.2 RELATED WORK

- A. Division 23 - Mechanical
 - 1. Hot Water Piping
 - 2. Gas Piping
 - 3. Ductwork

1.3 PERFORMANCE

- A. Provide performance as scheduled on drawings. Boiler shall be certified for up to 95% efficiency.

1.4 WARRANTIES

- A. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of eighteen (18) months from date of substantial completion. Heat exchanger and fuel burner shall be warranted for a period of five (5) years from date of substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. MAGNATHERM

- B. RBI Flexcore
- C. Camus Advantus

2.2 PERFORMANCE CRITERIA

- A. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 92% on 500 MBH input boilers and less and not less than 95% on larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68 deg. F.
- B. Boiler shall comply with ASME Section IV for 80 psig, max 200 deg. F (100 psig on 1500 MBH and larger units).
- C. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5-inch WC to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14-inch WC.
- D. Boilers shall be certified for low NOx by the TCEQ. NOx emissions shall not exceed 30 PPM when referenced at 3% O2 at all firing rates.
- E. The burner, gas train and controls shall conform to the requirements of I.R.I. /G.E. Gap.

2.3 BOILER DESIGN

- A. Each hot water boiler shall consist of a horizontal, stainless steel heat exchanger complete with trim, valve trains, burner, and boiler control system. The boiler manufacturer shall fully coordinate the boiler as to the interaction of its elements with the burner and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.
- B. Each boiler heat exchanger shall be stainless steel, counter-flow design for maximum heat transfer with the multiple sections arranged in a reverse return configuration to assure balanced flow through each section
- C. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.
- D. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.
- F. Boiler heat exchanger headers shall be fabricated steel and be completely removable for inspection. Seals shall be EPDM, rated for 400 deg F service. Push nipples or gaskets between the sections are not permitted.
- G. Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from minimum 16-gauge carbon steel. The front and top wall shall be secured in place with ¼ -20 NC bolts (sheet metal screws are not acceptable). The complete outer casing shall be finished, inside

and out, with a powder coat finish. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure an outer casing temperature of not more than 50°F above ambient temperature when the boiler is operated at full rated load.

- H. An observation port shall be located on the boiler to allow for observation of the burner flame.
- I. Boiler shall have a single condensing heat exchanger. A boiler that utilizes a secondary condensing heat exchanger is unacceptable.

2.4 BOILER TRIM

- A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:
 - 1. Safety relief valve shall be provided in compliance with the ASME code. Contractor is to pipe to acceptable drain.
 - 2. Water pressure-temperature gauge.
 - 3. Primary low water flow fuel cutoff (probe type with manual reset).
 - 4. Manual reset high limit water temperature controller.
 - 5. Operating temperature control to control the sequential operation of the burner.
 - 6. Separate inlet and outlet water temperature sensors capable of monitoring flow
 - 7. Exhaust temperature sensor
 - 8. Provide condensate neutralization kit (shipped loose).

2.5 BOILER FUEL BURNING SYSTEM

- A. The boiler manufacturer shall furnish each boiler with an integral, power type, straight gas, fully automatic fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements with the boiler heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.
- B. Each burner shall be provided with an integral gas firing combustion head.
- C. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gases.
- E. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel within the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. Static and total pressure capability shall comply with the requirements of the boiler. The blower shall operate at 6000 RPM maximum without undue vibration and noise and shall be designed and constructed for exposure to temperatures normal to its location on the boiler. The operating fan speed will be tachometer sensed and be capable of being displayed at the text-based display.
- F. Each burner shall of the radial-fired (down-fired) type and constructed of steel with a stainless-steel inner and stainless steel mesh outer screen.

- G. Each boiler shall be provided with a “Full Modulating” firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100% as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.
- H. The Micro Processor shall use a Proportional Integral Algorithm to determine the firing rate. The control must have the following capabilities:
 - 1. Maintain single set point
 - 2. Reset the set point based on outdoor air temperature.
 - 3. Boiler shutdown based on outdoor air temperature
 - 4. Internal dual set point program with an external switchover. (e.g. - night setback w/external clock, supplied by others)
 - 5. Alarm relay for any for any manual reset alarm function.
 - 6. Programmable Low Fire Delay to prevent short cycling based on a time and temperature factor for release to modulation.
 - 7. Text Based Display showing current supply and return temperatures, current set points as well as differential set points. It must also display any fault codes whether automatically reset or manually reset.
 - 8. Local Manual Operation.
 - 9. Remote Control System (Building Management / Sequencer Control) - The boiler control shall be capable of accepting a 0 -10vdc remote external analog signal to control the firing rate
 - 10. Computer (PC) interface for programming and monitoring all functions

2.6 MAIN GAS VALVE TRAIN

- A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:
 - 1. Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.
 - 2. Air – Gas ratio control (maximum inlet pressure 14-inch WC)
 - 3. One (1) low gas pressure switch (manual reset).
 - 4. One (1) high gas pressure switch (manual reset).
 - 5. Two (2) pressure test ports

2.7 IGNITION SYSTEM

- A. Each boiler shall be equipped for direct spark ignition

2.8 COMBUSTION AIR CONTROL SYSTEM

- A. Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:
 - 1. The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.

2. One (1) low airflow differential pressure switch to ensure that combustion air is supplied.
3. High exhaust back pressure switch

2.9 BURNER CONTROL SYSTEM

- A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The 120/1/60 power supply to each boiler shall be protected by a 15 Amp circuit breaker located in the MCC (supplied by contractor).
- B. The boiler shall include an electric spark ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.
- C. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.
- D. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.

2.10 BOILER CONTROL PANEL

- A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:
 1. One (1) burner "on-off" switch.
 2. One (1) electronic combination temperature control, flame safeguard and system control.
 3. Control circuit breaker, 5 amp
 4. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.
 5. Text Based Display Panel to adjust set points and control operating parameters. Text Based Display is to indicate burner sequence, all service codes (0-65), fan speed, boiler set point, and sensor values such as inlet, outlet, flue gas and outdoor air.

2.11 FACTORY TESTING - HYDROSTATIC

- A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME "H" stamp.

2.12 FACTORY TESTING - FIRE TESTING

- A. Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.

2.13 SEQUENCE CONTROLLER

- A. Boiler shall be provided with a boiler sequence controller that is capable of controlling, all condensing boilers. Controller shall be capable of communicating via BACNet protocol. Controller shall allow boiler or boilers to operate from a remote header sensor (header sensor provided by boiler manufacturer, installed by contractor). Controller shall be capable of allowing boiler or boilers to operate based on outdoor reset, see specification Section 23 09 33 for reset schedule. This shall be achieved by either, a) programming the controller with an outdoor air reset curve in conjunction with a separate outdoor air sensor (outdoor sensor shall be provided by boiler manufacturer, installed by contractor), b) setpoint control via 0-10 VDC analog communication with building automation system. Controller shall visually display relay status, firing rate of each boiler, header temperature, outdoor air temperature. Coordinate wiring of this controller with mechanical and control's contractor.

2.14 CARBON MONOXIDE MONITORING SYSTEM

- A. Provide and install a manual reset Carbon Monoxide Detector located within the boiler room. The Carbon Monoxide Detector and the boilers shall be interlocked so that the burners will not operate when the level of CO in the room rises above 50ppm. The Carbon Monoxide detector shall disable the boiler's burner upon loss of power to the detector.
- B. Carbon Monoxide Sensor with two-year warranty by U.S. Draft Co. Model CGM-605 with model XB expansion module or equivalent by International Gas Detectors (IGD)
 - 1. Provided with pre-programmed dry contacts to shut down equipment during unsafe operation.
 - 2. NEMA 1 Enclosure
 - 3. Complies with Texas State Boiler Code 65.603-2015
 - 4. Additional features shall include 0-10 VDC control signal out, visual alarm and audible alarm.
 - 5. Provide expansion board for additional equipment interlocks.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install isolation valves and unions on supply and return water lines to boiler.
- B. Install strainer, drain with valve, pressure, and temperature gauge on return water line to boiler.
- C. Install main gas cock, drip leg and union close to boiler.
- D. Install on 4" concrete pad and place into operation in accordance with manufacturer's instructions. Pipe as detailed on drawings.
- F. Provide Category IV vent stack material. Mechanical contractor shall coordinate draft requirements and other venting requirements between stack supplier and boiler supplier.

- G. Install boilers, piping, and accessories in accordance with the manufacturer's installation instructions and state boiler code.
- H. Pipe each gas relief vent to the outdoors, in accordance with the manufacturer's recommendations and the local codes.
- I. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.
- J. Contractor to route condensate connection from boiler and stack to acid neutralization kit and then to appropriate drain. Trap as required by boiler manufacturer.

3.2 BOILER MANUFACTURER STARTUP SERVICE

- A. Provide factory authorized startup services to assure its proper operation.
- B. Set the boiler operating and safety controls.
- C. Perform a flue gas analysis at the boiler outlet. Record the following results of the analysis:
 - 1. Carbon dioxide percent volume.
 - 2. Oxygen percent volume.
 - 3. Stack temperature.
 - 4. Calculated combustion efficiency.
- D. Do not operate the boiler for any reason until the factory startup service has been completed.
- E. Startup procedure shall include a functional test of Carbon Monoxide Detector. Simulate an alarm condition and demonstrate the functionality of the detector shutting down the appliances. Owner/Engineer shall be present to witness test.

END OF SECTION

SECTION 237223 - ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section includes units with integral heating and cooling for outdoor installation. Integral Energy Recovery device shall be a rotary air-to-air total enthalpy wheel. Integral heat source shall be Indirect Gas-Fired furnace. Integral cooling source shall be packaged DX. Airflow arrangement shall be Outdoor Air only. Each unit shall incorporate additional product requirements as listed in Section 2 of this specification.

1.2 RELATED WORK

- A. Division 23 - Mechanical
 - 1. Air Balance
 - 2. Controls
 - 3. Electrical Provisions of Mechanical Work
 - 4. Ductwork

1.3 REFERENCES

- A. UL 900 Flame Smoke Ratings
- B. National Electrical Code
- C. AHRI Standard 1060

1.4 SUBMITTALS

- A. Submit manufacturer's dimensioned product data sheets.
- B. Submit fan performance curve.
- C. Submit manufacturer's certified heat transfer data for heating and cooling coil capacity.
- D. Submit manufacturer's data on housing insulation material.
- E. Submit manufacturer's test data for UL 900 compliance of the exchanger core.

1.5 CAPACITY

- A. Refer to equipment schedule.

1.6 WARRANTY

- A. Provide a 10 year parts only warranty for the enthalpy exchanger core.
- B. Provide a 5 year parts and labor warranty for the remainder of the unit.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, condensate properly tapped, piping connections verified and leak tested, belts aligned and tensioned, all shipping braces have been removed, and fan has been tested under observation.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Inspect for transportation damage and store in a clean, dry location. Protect from weather and construction traffic.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:
 - 1. Greenheck Fan Corporation

2.2 MANUFACTURED UNITS

- A. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, exhaust air blower, evaporator coil, energy wheel, hot gas reheat coil, indirect gas-fired furnace, packaged DX system, motorized dampers, filter assembly intake air, supply air blower assembly, exhaust/relief blower assembly, filter assembly for exhaust air, and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection except with electric post heat and exhaust fan only power which have dual point power.

2.3 CABINET

- A. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
 - 1. Materials: Rigid urethane injected foam. Foam board not acceptable.
 - a. Thickness: 2 inch (50.8 mm)
 - b. Thermal Resistance R13
 - c. Thermally broken

- d. Meets UL94HF-1 flame requirements.
 - e. Location and application: Full coverage of entire cabinet exterior to include walls, roof of unit, unit base, and doors.
- 2. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
 - a. Thickness: 2 inch (50.8 mm)
 - b. Thermal Resistance R8
 - c. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
 - d. Location and application: Divider panels between outdoor air and return air/exhaust air streams.
- B. Roof Insulation: 2 inch (50.8 mm) fiberglass located above the 1 inch (25.4 mm) foam panel.
- C. Supply Air blower assemblies: Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.
- D. Exhaust Air blower assemblies: Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.
- E. Evaporator Coil: Evaporator coil shall be (silver) soldered or brazed into the compressed refrigerant system. Coil shall be constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame. If two compressors are used as components of the unit, then the evaporator coil shall be of "interlaced" configuration, permitting independent operation of either compressor without conflict with the other compressor.
- F. Control panel / connections: Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. RTU shall be equipped with a Unit Disconnect Switch.
- G. Condensate drain pan: Drain Pan shall be an integral part of the unit whenever a cooling option is included. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.
- H. P trap: If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.
- I. Energy wheel: Unit energy wheel shall be sized for the full volume of outdoor and exhaust air without an energy wheel bypass damper(s). Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned urethane drive belt or a link style belt with a five-year warranty. The wheel media shall be a polymer film matrix in a stainless-steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not

acceptable. Silica gel desiccant shall be permanently bonded to the polymer film and is designed and constructed to permit cleaning and servicing. The energy wheel is to have a five-year warranty. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.

- J. Modulating frost control. Control system shall include an outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.
- K. Reheat coil with factory installed modulating hot gas reheat valve.
- L. Indirect gas furnace
 1. Shall be ETL Certified as a component of the unit.
 2. Shall have an integral combustion gas blower.
 3. Shall be ETL Certified for installation downstream of a cooling coil.
 4. Shall have fault sensors to provide fault conditions to optional digital controller or building controls.
 5. Shall have 4-pass tubular heat exchangers, constructed of type 409 stainless steel. Heat exchanger tubes shall be installed on the vest plate by means of swaged assembly, welded connections are not acceptable. Heat exchanger tubes shall be supported by a minimum of two fabricated assemblies that support the tubes and permit expansion and contraction of the tubes.
 6. Heat exchanger shall have a 25-year extended warranty.
 7. Furnace control shall be 4:1 Modulating.
 8. Shall be encased in a weather-tight metal housing with intake air vents. Large, metal lift-off door shall provide easy access to the enclosed vest plate, control circuitry, gas train, burner assembly and exhaust blower.
 9. Shall have solid state controls permitting stand-alone operation or control by building controllers.
- M. Packaged DX System: Unit shall have an integral compressor(s) and evaporator coil located within the weather-tight unit housing. Condenser coils shall be all-aluminum micro channel design appurtenant condenser fan assemblies shall be factory installed as integral subassemblies of the unit and mounted on the unit's exterior. Lead condenser fan(s) will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point.] Motors shall be UL Recognized and CSA Certified. The lead refrigerant compressor shall be inverter hermetic scroll-type. Additional compressor shall be single stage hermetic scroll-type paired in tandem with lead inverter compressor. Compressors shall be equipped with liquid line filter drier, electronic expansion valves (EEV) or thermostatic expansion valves (TXV) on non-inverter compressor circuits, manual reset high pressure and low pressure cutouts and all appurtenant sensors, service ports, leak detection sensors and safety devices. Compressed refrigerant system shall be fully charged with R-454B refrigerant. Compressors shall be mounted within an insulated access compartment and on a raised cabinet shelf to reduce sound and vibration. Each compressor shall be factory-equipped with an electric crankcase heater to boil off liquid refrigerant from the oil.
- N. Condenser Fans: Fan blades must be constructed of aluminum or a composite material and have a geometry designed and documented to reduce sound and energy when compared to a traditional rectangular blade fan. Traditional rectangular blade fans are not allowed due to increased noise generated and increase power utilized. Condenser fan motors shall be three phase, external rotor, type 56 frame, open air over and shaft up. Each condenser fan motor shall have a vented frame, rated for continuous duty and be equipped with an automatic reset thermal

protector. Lead condenser fan(s) will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point.] Motors shall be UL Recognized and CSA Certified. Single condenser fan running at max RPM and design static pressure shall not exceed an A-weighted sound power level of 75 db at free inlet/outlet test conditions.

- O. Packaged DX Control and Diagnostics: The Packaged DX system shall be controlled by an onboard digital controller (DDC) that indicates both owner-supplied settings and fault conditions that may occur. The DDC shall be programmed to indicate the following faults:
 - 1. Global alarm condition (active when there is at least one alarm)
 - 2. Supply Air Proving alarm
 - 3. Compressor Trip alarm
 - 4. Compressor Locked Out alarm
 - 5. Supply Air Temperature Low Limit alarm
 - a. Sensor #1 Out of Range (outside air temperature)
 - b. Sensor #2 Out of Range (supply air temperature)
 - c. Sensor #3 Out of Range (cold coil leaving air temperature)
- P. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.
- Q. 24V/120V Smoke detector: Duct smoke detector is shipped loose for field mounting and wiring in the supply or return air duct. The air duct smoke detector housing shall be UL listed per UL 268A specifically for use in air handling systems. The air duct smoke detector housing shall be suitable for mounting indoors. The detector shall operate at air velocities of 100 feet per minute to 4000 feet per minute (0.5 to 20.32 meters/second). The power supply voltage shall be 20-29 VDC, 24 VAC 50-60 Hz, and 120 VAC 50-60 Hz. The detector shall consist of an alarm initiation contact and two DPDT auxiliary contact closures. WARNING: Duct smoke detectors are NOT a substitute for open area smoke detectors; NOT a substitute for early warning detection; NOT a replacement for a building's regular fire detection system. Refer to NFPA 72 and 90A for additional information.

2.4 BLOWER

- A. Blower section construction, Supply Air: direct drive motors and blowers shall be assembled on a 14 gauge galvanized steel platform and shall be equipped with 1.125 inch thick neoprene vibration isolation devices.
- B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
- C. Fan: Direct drive, airfoil plenum fan with steel wheel statically and dynamically balanced. Prop or belt-drive fan not acceptable due to low static capabilities.
- D. Blades: Painted steel blades only.
- E. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

2.5 MOTORS

- A. General: Blower motors greater than 1/2 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPA minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.
- B. Motors shall be 60 cycle, 3 phase 460 volts.

2.6 FILTERS

- A. Unit shall have permanent 2 inch (50.8 mm) aluminum filters located in the outdoor air intake and shall be accessible from the exterior of the unit. MERV 8 disposable pleated filters shall be provided in the supply air stream. MERV 8 disposable pleated filters shall be provided in the supply final air stream and MERV 8 filters in the exhaust air stream.

2.7 ROOF CURB

- A. Install a roof curb of the same manufacture as the air conditioning unit.
 - 1. Curb to support the unit and provide a watertight enclosure to protect ductwork and utility services.
 - 2. Use a design complying with National Roofing Contractors Association requirements.
 - 3. Level curb according to manufacturer's recommendations.

2.8 CONTROLS

- A. Factory installed and tested BacNET direct digital controls to be interfaced with BMCS.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
- B. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
- C. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.3 CONNECTIONS

- A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
- B. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
- C. Duct installation and connection requirements are specified in Division 23 of this document.
- D. Electrical installation requirements are specified in Division 26 of this document.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A / E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.5 START-UP SERVICE

- A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

END OF SECTION

SECTION 237613 - EVAPORATIVE FLUID COOLER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide packaged industrial fluid cooler as shown.
 - 1. Designed for outdoor operation.
- B. Equipment capacity as scheduled.
 - 1. Motors for mechanical equipment.

1.2 SUBMITTALS

- A. Submit shop drawings and product data as specified.
- B. Submit pressure drop through the closed circuit coils.
- C. Submit foundation requirements and operating weight.
- D. Submit manufacturer's certified capacity curve with selections plotted thereon.
- E. Submit manufacturer's installation, start-up and service instructions.
- F. Submit wiring diagram.

PART 2 - PRODUCT

2.1 ACCEPTABLE MANUFACTURERS

- A. Marley.
- B. Baltimore Air Control.
- C. Evapco.

2.2 UNIT HOUSING

- A. The casing panel, collection basin, air inlet structure and fill/coil supports shall be constructed of heavy-gauge Series 300 stainless steel. A factory-installed, float operated, mechanical make-up valve shall be included. An overflow and drain connection shall be provided in each cell. The basin floor shall slope towards the drain to allow complete flushing of debris. The collection basin shall be tested for leaks at the factory.

2.3 FAN

- A. Fan(s) shall be axial propeller-type, incorporating aluminum alloy blades driven directly by Direct Drive (AC) fans with inverter duty motors to be controlled by an ABB ACH580 NEMA1 VFD. The VFD will be integrated in the NEMA 3R painted steel control panel for the assembly of the fan, fan motor, fan cylinder and fan guard to reduce vibration potential and maintenance. Fan drive(s) shall require no periodic bearing

greasing, belt tensioning or belt alignment. Fan motor(s) shall have protection class IP55 and include moisture and hot climate protection. Fan motor(s) shall be nameplated for 3 phase, 60 Hz, 460 volt operation.

2.5 HEAT TRANSFER COILS

- A. Cooling coil(s) shall be constructed of corrosion resistant copper tubing and headers, supported by stainless steel tube sheets with high temperature grommet inserts for contact isolation. Coil(s) shall be tested at 350 psig air pressure under water.

2.5 HEAT TRANSFER FILL

- A. Cross-corrugated counterflow film fill media, thermoformed from 12 mil thick PVC, shall be included to enhance evaporative heat transfer. Fill packs shall be easily inspected or removed and replaced through access doors in the fill section of the fluid cooler.

2.6 WATER DISTRIBUTION SYSTEM

- A. Distribute water uniformly over the coils at a flow rate to ensure complete wetting of the coil at all times.
- B. Arrange orifices or nozzles for quick removal for cleaning or flushing.

2.7 WATER RECIRCULATING PUMP

- A. Recirculating water pump(s) shall be centrifugal with mechanical seal, mounted to the collection basin in conjunction with a suction assembly, and close-coupled with a TEFC pump motor nameplated for 3 phase, 60 Hz, 460 volt operation. Recirculating water piping shall be schedule 80 PVC.

2.8 DRIFT ELIMINATORS

- A. Drift eliminators shall be 17 mil thick PVC with a minimum of three changes in air direction and shall limit drift losses to 0.001% or less of the design recirculating water flow rate. Eliminators shall be easily inspected or removed and replaced through access doors in the upper section of the fluid cooler.

2.8 ACCESSORIES

- A. Furnish waste water bleed line to overflow with adjustable valve.
- B. Brass makeup float valve.
- C. Lift out hot-dip galvanized steel strainer of antivortexing design.
- D. A man-sized access panel for maintenance of pump and fan motor.

2.9 BASIN HEATER

- A. Provide an electric immersion heater in the basin to protect against freezing at 20°F ambient.
 - 1. Provide controls required for automatic operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and start-up the system in accordance with the manufacturer's installation, start-up and service instructions.

END OF SECTION

SECTION 238121 - SINGLE PACKAGE ROOFTOP AIR CONDITIONERS (w/gas-fired heat)

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide and install a single-package, single-zone, electric air conditioner with gas-fired heat and hot gas reheat for rooftop application.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork.
 - 2. Air Balance.
 - 3. Electrical provisions for mechanical work.
 - 4. Air Filtration.

1.3 PERFORMANCE

- A. As scheduled on drawings, with head pressure control to enable unit start and operate down to 20 degrees F ambient.

1.4 SUBMITTALS

- A. Manufacturer's certified capacity data
- B. Submit manufacturer's installation, start-up and service instructions.
- C. Submit recommended clearance dimensions for air flow and service.
- D. Submit coordination drawings as specified. Consideration shall be given to adjacent structures and their effect on air flow patterns.
- E. Submit internal wiring diagram of Control Center
- F. Submit sequence of operation in narrative form.
- G. Mark-up a copy of the specifications indicating in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. AAON
- B. Substitute equipment may be considered for approval that includes at a minimum:
 - 1. R-454B refrigerant
 - 2. Variable capacity compressor with 10-100% capacity control
 - 3. Direct drive supply fans
 - 4. Double wall cabinet construction
 - 5. Insulation with a minimum R-value of 13
 - 6. Stainless steel drain pans

2.2 Rooftop Units

- A. General Description
 - 1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, gas heaters, and unit controls.
 - 2. Unit shall be factory assembled and tested including leak testing of the DX coils, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
 - 3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 - 4. Unit components shall be labeled, including electrical and controls components.
 - 5. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
 - 6. Installation, Operation, and Maintenance manual shall be supplied within the unit.
 - 7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
 - 8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
- B. Construction
 - 1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
 - 2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
 - 3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel, and prevents exterior condensation on the panel.
 - 4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in ARI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access

doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. Access to filters, dampers, cooling coils, heaters, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. 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.
8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
9. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
10. Unit shall include lifting lugs on the top of the unit.
11. Unit base shall be fabricated of 1 inch thick double wall, impact resistant, rigid polyurethane foam panels.

C. Electrical

1. Unit shall have a 5kAIC SCCR.
2. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
3. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

D. Supply Fans

1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
3. Unit shall include barometric relief dampers.

E. Cooling Coils

1. Evaporator Coils
 - a. Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
 - b. Coils shall be hydrogen or helium leak tested.
 - c. Coils shall be furnished with factory installed expansion valves.
2. Unit shall be factory charged with R-454B refrigerant.
 - a. Coils shall be designed for use with R-454B refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.

F. Gas Heating

1. Unit shall include a natural gas furnace with 4 stages of capacity control.
2. Aluminized steel heat exchanger furnace shall carry a 15-year non-prorated warranty, from the date of original equipment shipment from the factory.
3. Gas furnace shall consist of aluminized steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.

4. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
5. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.

G. Filters

1. Unit shall include 4-inch thick, pleated panel filters with an ASHRAEMERV rating of 13, upstream of the cooling coil. Unit shall also include 2-inch thick, pleated panel pre filters with an ASHRAE MERV rating of 8, upstream of the 4-inch standard filters.
2. Unit shall include a clogged filter switch.
3. Unit shall include a Magnehelic gauge mounted in the controls compartment.

H. Controls

1. Factory Installed and Factory Provided Controller
 - a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 - b. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 - c. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
 - d. Single Zone VAV Controller
2. Unit shall utilize a variable capacity compressor system and a variable speed fan system to modulate the cooling and airflow as required in meeting the space temperature needs and to save unit operating energy. Unit fan speed shall modulate based on space temperature, not supply air pressure.
3. Unit shall be provided with supply air temperature control. Mixing boxes and bypass ducts shall not be required for operation as a single zone VAV system.
 - a. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a LonWorks or BACnet network. [Orion Controls System]

2.3 ROOF CURB

- A. Install a roof curb of the same manufacture as the air conditioning unit.
1. Curb to support the unit and provide a watertight enclosure to protect ductwork and utility services.

2. Use a design complying with National Roofing Contractors Association requirements.
3. Level curb according to manufacturer's recommendations.

2.4 CONVENIENCE OUTLET

- A. Provide 115 volt outlet in unit cabinet.

2.5 MOTORIZED OUTSIDE AIR DAMPER

- A. Low leakage 14-gauge galvanized steel
 1. Airfoil Blades
 2. Ruskin CD60

2.6 DEHUMIDIFICATION PACKAGE

- A. Provide sub-cooling / reheat dehumidification coil located downstream of the evaporator coil. Dehumidification coil shall be same size as evaporator coil.

2.7 HUMIDISTAT

- A. Wall mounted
- B. Shall control activation of dehumidification coil
- C. Humidity levels between 20% to 80% relative humidity.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's recommendations and as shown on drawings.
- B. Unit is to be provided with a through-the-bottom service connection accessory package and must be used for electrical connections to unit. Use bulkhead connectors to make a waterproof connection.
- C. Seal all duct connections to roof curb for air tight connection. Install a 90 degree flanged ductwork connection to the roof curb. Provide and install gasketing around duct flanges. Provide and install gasketing around outer edge of roof curb.

3.2 STARTUP

- A. Provide the services of a factory trained service technician employed full time by the unit manufacturer to start-up the system, or manufacturer's factory authorized representative under the supervision of the factory trained service technician. Upon completion of the installation, the system shall be started and commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system. The factory authorized representative will verify that accessories are installed and performing the specified functions. (Contractor startup is unacceptable.)
- B. The written startup report shall be provided to the owner and engineer upon completion.

END OF SECTION

SECTION 238146 - WATER TO AIR HEAT PUMP UNIT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install water to air heat pump units.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Electrical provisions of mechanical work
 - 2. Pipe and pipe fittings
 - 3. Vibration isolation

1.3 REFERENCES

- A. AHRI 320 – Water Source Heat Pumps
- B. AHRI 410 – Forced Circulation Air Cooling and Air Heating Coils
- C. National Electrical Code

1.4 SUBMITTALS

- A. Submit manufacturer's dimensioned product data sheets.
 - 1. Show location of filter access doors.
- B. Submit fan performance curve for each unit:
 - 1. Plot fan volume against static pressure, horsepower, and efficiency.
 - 2. Show point of rating based on static requirements of the system.
- C. Submit the fan performance plot at each motor speed position with consideration for the reduced internal static.
- D. Submit a chart of specific sound power level at each octave band center frequency.
- E. Submit manufacturer's certified heating and cooling coil capacity data.
- F. Submit filter manufacturer's product data sheets and capacity information.
- G. Submit manufacturer's data on housing insulation material.

1.5 WARRANTY

- A. Provide a manufacturers warranty to include parts and labor for a period of two years from substantial completion.

1.6 ACCEPTABLE MANUFACTURERS

- A. Climate Master
- B. York
- C. Daikin
- D. Trane

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Hermetic compressors
- B. DX coil sections
- C. Condensate drain pan lined
- D. Water cooled heat exchanger
- E. Unit capacity as scheduled

2.2 CONTROL SYSTEM

- A. Control system shall be factory wired.
 - 1. Installed so that the unit can be serviced without shutting down the system.
 - 2. Panel wiring shall be UL approved.
 - 3. Each circuit fused.
- B. Safety devices shall be monitored and interlocked to prohibit compressor short cycling.
- C. Provide identified terminal strips for low voltage terminal wiring.
- D. Provide equipment for heat pump reverse cycle operation.
- E. Provide with BACNET control interface.

2.3 EVAPORATOR FAN ASSEMBLY

- A. Provide with:
 - 1. V-belt drive assembly and motor with totally enclosed belt guard.
- B. Drive assembly:
 - 1. Sized for 50% overload
 - 2. Matched belts
- C. Provide adjustable pitch motor pulley.

- D. Provide motor and fan pulley of cast iron keyed to the shaft.
- E. Motor selected so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate rating.
- F. Supply fans shall be double width, double inlet, forward curve blades.
- G. Fans shall be:
 - 1. Statically and dynamically balanced
 - 2. Tested after being installed in the fan sections
 - 3. Selected for the design air quantities and pressure of the system
 - 4. Mounted on a common shaft if multiple wheels
- H. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.
- I. Nominal fan outlet velocities shall not exceed 1800 fpm.
- J. Fan bearings:
 - 1. Permanently lubricated
 - 2. Self-aligning
 - 3. Selected for an average life of 200,000 hours

2.4 CONDENSATE DRAIN PANS

- A. IAQ style drain pans shall be provided under all coils.
 - 1. Pitch to drain connection
 - 2. Fabricated from 16-gauge 304 stainless steel
 - 3. Triple pitched for complete drainage with no standing water
 - 4. Insulated to prevent condensation
 - 5. Welded corners
 - 6. Stainless drain connection

2.5 EVAPORATOR COIL

- A. Reference Schedule.

2.6 WATER COOLED HEAT EXCHANGER

- A. Tube-in-tube or shell and coil condenser with continuous copper tubing.
 - 1. Construction shall be in accordance with ASME safety code.

2.7 CONDENSER COIL PIPING CONNECTION

- A. Provide a flexible stainless steel braided hose.
 - 1. Minimum of two feet long
 - 2. Fixed MPT on one end and a swivel with adapter on the other.
 - 3. Suitable for water temperatures ranging from 23°F to 211°F without the use of glycol.

- B. Reference Details and Specification Section 23 05 23.

2.8 CABINET

- A. Corrosion resistant galvanized steel construction
- B. Provide a duct flange on four sides of the return air inlet and supply air outlet of the unit.
 - 1. Sized to permit connection of the flexible connection to the ductwork
 - 2. Extend beyond the primary drain pan
 - 3. Minimum dimension 2"
- C. Provide insulated, removable panels for access to the interior.
 - 1. Plated captive screws and nuts
 - 2. Neoprene gaskets
- D. Internally insulate the entire unit with neoprene coated, 1-1/2 lb. density glass fiber insulation, applied to internal surfaces with adhesive and weld pins. Coat exposed edges of insulation with adhesive.
- E. Insulation, vapor barriers, facings, and adhesives:
 - 1. Flame spread not higher than 25
 - 2. Smoke developed rating not higher than 50
- F. Condensation on the exterior of the cabinet is not approved.

2.9 COMPRESSOR

- A. Equip each compressor with:
 - 1. High- and low-pressure protection
 - 2. Loss of charge protection
 - 3. Current sensitive overload relays
- B. Provide suitable vibration isolators
- C. Locate the compressors in a sound attenuating compartment located in the unit cabinet.
- D. Provide refrigerant not scheduled for phase out.
- E. Provide each refrigeration compressor with a parts and labor warranty against failure for a period of five years from the date of acceptance.
 - 1. The warranty shall indicate model, serial number of the unit and commencing date. (Commencing date shall not start prior to substantial completion.)
 - 2. The warranted compressor assembly consists of the starter, rotor, eccentric shaft, eccentric rods, pistons, wrist pins, suction valves, discharge valves, unloading mechanisms, oil pump, and the housing in which these parts are enclosed.

2.10 FILTERS

- A. Filter section shall contain 1" thick disposable filters.

- B. Arrange the filter section to permit filter change without unit shutdown or cabinet panel removal.
 - 1. Give particular attention to construction of filter section to ensure easy removal of filters.

2.11 SPACE THERMOSTAT

- A. Provide a space thermostat for remote wall mounting.
- B. Provide for individual heating and cooling setpoint adjustment.
 - 1. Automatic heating-cooling change over with dead band setting.
- C. Subbase controls.
 - 1. System "On-off".
 - 2. Fan "On" in system "On" position.
- D. Provide with locking Lexan Thermostat Guard with circulation holes on sides only.

PART 3 - EXECUTION

3.1 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for use after the warranty period.
 - 1. One spare fan motor for each size of fan motor on the project
 - 2. One spare set of filters or filter media for each fan coil unit on the project

3.2 ELECTRICAL REQUIREMENTS

- A. Bring electrical connections to a common junction box.

3.3 STORAGE

- A. Storage and shipping in accordance with manufacturer's recommendations.

3.4 INSTALLATION

- A. Install and start-up the system in accordance with the manufacturer's installation start-up and service instructions.
- B. The heat pump unit shall be self-contained, factory assembled.
 - 1. Pressure tested, dehydrated, and charged with refrigerant and oil.

END OF SECTION

SECTION 238218 - DUCTLESS MINI SPLIT DX UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install mini split system. Complete with a slim silhouette, compact, high wall mounted indoor fan coil section with wireless remote controller and a slim silhouette horizontal discharge outdoor condensing unit. Unit shall be provided with constant speed compressor, pre-charged with R410A refrigerant. air-cooled condensing units complete with casing, compressor, condenser coil, condenser fan and controls required for a split air conditioning system.

1.2 RELATED WORK

- A. Refrigerant Piping.
- B. Electrical Provisions of Mechanical Work.

1.3 PERFORMANCE

- A. Provide performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

1.4 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210 and bear the AHRI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 Quality assurance Standards and ISO 14001 which are set of standards applying to sustainability and environmental protection set by the International Standard Organization (ISO).
- E. A pressure charge of R410A refrigerant sufficient for up to twenty-five (25) feet of refrigerant tubing shall be provided in the outdoor condensing unit.
- F. A dry air holding charge shall be provided in the indoor section.
- G. System efficiency shall meet or exceed 13.0 SEER.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Daikin
- B. LG
- C. Mitsubishi Electric

2.2 INDOOR UNIT GENERAL

- A. The indoor shall be factory assembled, wired and run tested. Contained within the unit cabinet shall be all factory wiring, internal piping, electronic control circuit board and fan with fan motor.
- B. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and auto restart after power interruption function, an emergency operation function and a test run switch.
- C. Indoor unit and refrigerant pipes shall be charged with dry air before shipment from the factory. All refrigerant piping must be insulated.

2.3 UNIT CABINET

- A. The casing shall have a smooth front, top return, in a Munsell No. 1.0Y 9.2/0.2 white finish.
- B. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
- C. There shall be a separate installation plate which secures the unit firmly to the wall. Secure mounting of plate and all mounting hardware shall be furnished by and be the responsibility of the installer.

2.4 FAN

- A. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor mounted in rubber motor mount.
- B. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
- C. Manual adjustable vertical guide vanes shall be provided with the ability to change the airflow from side to side (left to right).
- D. An integral, motorized, horizontal air sweep flow louver shall provide an automatic change in airflow by directing the air up and down to provide for uniform air distribution.
- E. The indoor unit fan motor shall operate in four (4) selectable speeds, Powerful, High, Medium, and Low.

2.5 FILTER

- A. Return air shall be filtered by means of easily removed, washable, Catechin air filter and an anti-allergy enzyme filter – blue bellows type.

2.6 COIL

- A. The indoor unit (evaporator) coil shall be of nonferrous construction with smooth, pre-coated aluminum fins on copper tubing.
- B. Tubing shall have inner grooves for high efficiency heat exchange.
- C. All tube joints shall be brazed with PhosCopper or silver alloy.
- D. The coil shall be pressure tested at the factory.
- E. A sloped condensate pan and drain with extension hose shall be provided under the coil. Drain connections shall be provided at each end of the drain pan. (Option: A condensate mini pump shall be provided to provide a means of condensate disposal when a gravity drain is not available.)

2.7 ELECTRICAL

- A. The unit shall be equipped with a micro-processor control system directing indoor and outdoor unit coordinated operation.
- B. The indoor unit shall not have any supplemental electrical heat elements.

2.8 CONTROL

- A. This system shall have a wireless remote controller to perform input functions necessary to operate the system. The controller shall consist of a Power On / Off switch, Mode Selector, Temperature Setting, Timer Control, Fan Speed Select and Auto Vane Selector.
- B. Temperature changes shall be by 1°F increments with a range of 65°F to 87°F.
- C. There shall be a 24 hour On / Off timer.
- D. The unit shall have an emergency operation mode to allow operation without the remote controller.
- E. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless remote controller, providing emergency operation and controlling the outdoor unit.
- F. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.
- G. The system shall be capable of automatic restart when power is restored after power interruption.

- H. The control system shall control the operation of the air sweep louvers, as well as provide on / off and system / mode function switching.

2.9 OUTDOOR UNIT GENERAL

- A. The outdoor unit is designed specifically for use with MS series indoor units. These units are equipped with a circuit board that interfaces to the MS indoor unit circuit board. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested at the factory.
- B. When refrigerant lines are exposed on exterior of building provide “LINE-HIDE” line set cover system.
 - 1. Material, Weather resistant, UV stabilized, ASA/PVC/ABS/Poly/PE
 - 2. Assembly Screws, stainless steel.

2.10 UNIT CABINET

- A. The casing shall be fabricated from zinc coated steel, bonderized with an electrostatically applied, thermally bonded, acrylic or polyester powder coating for corrosion protection.
- B. Case and mounting feet shall be as follows:
 - 1. The MS-A09WA base shall be of Aluminum-Zinc-Magnesium alloy coated steel, with welded mounting feet.
 - 2. The base for the MS-A12WA shall have a galvanized steel base with welded mounting feet.
- C. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.

2.11 FAN

- A. The unit shall be furnished with a directive drive propeller type fan, statically and dynamically balanced for smooth and quiet operation.
- B. The fan motor shall have inherent protection, be equipped with permanently lubricated bearings. The fan motor shall be mounted and isolated for quiet operation.
- C. The fan shall be provided with a raised guard to prevent contact with moving parts.
- D. The outdoor unit shall have horizontal discharge airflow.

2.12 COMPRESSOR

- A. The compressor shall be a high performance, hermetic, rolling piston, rotary type.
- B. Compressor shall be mounted using rubber isolating bushings to avoid the transmission of vibration.

- C. Compressor shall be protected by an automatic over current relay and a thermal overload switch.

2.13 OPERATION

- A. The outdoor unit shall have an accumulator.
- B. The outdoor unit must have the ability to operate with a maximum height difference of 35 feet between indoor and outdoor units.
- C. The unit shall have a maximum refrigerant tubing length of 65 feet between indoor and outdoor units without the need for line size changes, traps or additional oil. All refrigerant lines must be insulated.
- D. The unit shall be pre-charged for a maximum of 25 feet of refrigerant tubing.

2.14 ELECTRICAL

- A. The electrical power of the system shall be 115 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 103 volts to 127 volts.
- B. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount condensing units on 4" foundation pads and pipe as shown on Drawings or as recommended by the equipment manufacturer. Install refrigerant filter dryer and sight indicating glass.
- B. Install units on vibration isolation pads.

3.2 CONTROL WIRING

- A. Furnish and install control wiring as required. Install control wiring in conduit.

3.3 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.
- B. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

3.4 WARRANTY

- A. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from the date of the original installation. The compressor shall have a warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

3.5 START-UP

- A. Follow the manufacturer's start-up procedures.
- B. Provide flexible elastomeric rubber closed cell insulation to prevent condensation from occurring on suction piping. After completion of successful start-up, installing contractor shall seal all openings in insulation and apply a protective aluminum sheetmetal jacket over insulation exposed on exterior of building.

END OF SECTION

SECTION 260105 - ELECTRICAL OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile electrical product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare electrical operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit 3 copies of complete manual in final form.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Architect / Engineer's stamp of acceptance (including re-submittals), submit for review 1 copy of the first draft of the Electrical Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Architect / Engineer's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of LED light sources
 - 12. Schedule of Fuses
 - 13. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the (3) completed manuals in final form to the Architect / Engineer.
 - 1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 - 2. Include all specified data, test reports, drawings, dated warranties, certificates, along with other materials and information.
- D. The Architect / Engineer shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required. The manuals will not be retransmitted.

- F. Three complete manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - Submission

2.1 Digital Submission

- A. Submit the Electrical Operating and Maintenance Manual in PDF format, organized with a hyperlinked table of contents for easy navigation.
- B. Ensure all drawings, warranties, and product data are searchable PDFs with clear annotations.
- C. Content Organization:
1. Digital copies should be structured into logical sections, including:
 - Table of Contents with bookmarks.
 - Warranties, certifications, and training documentation.
 - Shop drawings, equipment schedules, and O&M procedures.
 - Spare parts list and service contacts.

PART 3 - EXECUTION

3.1 ELECTRICAL OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
 2. Format:
 - a. Size: 8-1/2" x 11"
 - b. Text: Manufacturer's printed data or neatly typewritten.
 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable
 - c. Identity of general subject matter covered in the manual.
- B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:

- 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement
 - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Control and flow diagrams
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts:
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) Summer and winter operating instructions
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting
 - 3) Disassembly, repair and reassembly
 - 4) Alignment, adjusting and checking
 - 5) Routine service based on operating hours
 - d. Servicing and lubrication schedule

- 1) List of lubricants required
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Copies of typed circuit directories of panel board to reflect actual room graphics numbers and room names (not architectural room numbers from the drawings).
 - 1) Electrical
 - 2) Controls
 - 3) Communications
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear
 - 2) Items recommended to be stocked as spare parts
 - h. Schedule of fuses
 - i. Complete equipment field accessible internal wiring diagrams
 - j. Schedule of LED lighting sources.
 - k. Each Contractor's coordination drawings
 - l. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
 - m. Other data as required under pertinent sections of the specifications
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 4. Provide complete information for products specified in Division 26.
 5. Provide certificates of compliance as specified in each related section.
 6. Provide start up reports as specified in each related section.
 7. Provide signed receipts for spare parts and material.
 8. Provide training report and certificates.

END OF SECTION

SECTION 260500 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, and Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.
- B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Electrical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department adopted codes with amendments
 - 5. National Electrical Code with local amendments
 - 6. State Regulatory Agencies
 - 7. Where the project is located outside a municipal jurisdiction, and has no municipal inspection services, the National Electrical Code with amendments of the municipality with extraterritorial jurisdiction shall govern.
 - 8. Where the project is located outside any municipal jurisdiction, including extraterritorial jurisdictions, the National Electrical Code with local adopted amendments of the largest municipality located in the same county or parish shall govern.
 - 9. International Energy Conservation Code
 - 10. National Electrical Safety Code
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.

2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, APWA, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date proposals are received. Referenced specifications and standards are minimum requirements for all equipment, material and work. In instances where specified capacities, size or other features of equipment, devices or materials exceed these minimums, meet specified capacities.
- B. Use electrical materials and equipment that is constructed and tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized commercial standard. If materials and equipment is labeled, listed, or recognized by any Nationally-Recognized Testing Laboratory (NRTL) acceptable to the Occupational Safety and Health Administration (OSHA), then provide NRTL-labeled, listed, or recognized material and equipment. Acceptable NRTLs include but are not limited to:
 1. Underwriters Laboratories, Inc. (UL)
 2. Factory Mutual Research Corp. (FMRC) (also referred to as “Factory Mutual Global,” or “FM Global”)
 3. Intertek Testing Services NA, Inc. (ITSNA, formerly ETL)
 4. Canadian Standards Association (CSA)
 5. A complete listing of acceptable NRTLs is published on the OSHA website at <http://www.osha.gov/dts/otpca/nrtl/>.
- C. Where material and equipment is not labeled, listed, or recognized by any NRTL, provide a manufacturer’s Certificate of Compliance indicating complete compliance of each item with applicable standards of NEMA, ANSI, ASTM, or other recognized commercial standard.
- D. Do not install or use electrical material or equipment for any use other than that for which it was designed, labeled, listed, or identified unless formally approved for such use by the Owner’s AHJ. This *National Electrical Code*® requirement is re-stated for emphasis.
- E. Codes and Standards applicable to this Division:
 1. ANSI – American National Standards Institute
 - a. ANSI Z535.1, Safety Colors
 - b. ANSI Z535.2, Environmental and Facility Safety Signs
 - c. ANSI Z535.3, Criteria for Safety Symbols
 - d. ANSI Z535.4, Product Safety Signs and Labels
 2. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers:
 - a. ASHRAE Standard 90.1, *Energy Standards for Buildings Except for Low Rise Residential Buildings [ANSI, IESNA]*
 3. ASTM – American Society for Testing and Materials
 4. ICC – International Code Council
 - a. International Building Code® (IBC)

- b. International Existing Building Code® (IEBC)
5. ICEA – Insulated Cable Engineers Association
 - a. ICEA S-93-639, *Shielded Power Cables 5-46kV* (NEMA WC-74)
6. IEEE® - Institute of Electronics and Electrical Engineers
 - a. IEEE C2™, *National Electrical Safety Code* (NESC) [ANSI]
 - b. IEEE Std 141™, *Recommended Practice for Electric Power Distribution for Industrial Plants* (“Red Book”)
 - c. IEEE Std 143™, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* (“Green Book”)
 - d. IEEE Std 241™, *Recommended Practice for Electric Power Systems in Commercial Buildings* (“Gray Book”)
 - e. IEEE Std 242™, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* (“Buff Book”)
 - f. IEEE Std 315™, *Graphic Symbols for Electrical and Electronics Diagrams*
 - g. IEEE Std 399™, *Recommended Practice for Power Systems Analysis* (“Brown Book”)
 - h. IEEE Std 446™, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications* (“Orange Book”)
 - i. IEEE Std 493™, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (“Gold Book”)
 - j. IEEE Std 519™, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*
 - k. IEEE Std 739™, *Recommended Practice for Energy Management in Industrial and Commercial Facilities* (“Bronze Book”)
 - l. IEEE Std 902™, *Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems* (“Yellow Book”)
 - m. IEEE Std 1015™, *Recommended Practice Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems* (“Blue Book”)
 - n. IEEE Std 1100™, *Recommended Practice for Powering and Grounding Electronic Equipment* (“Emerald Book”)
 - o. IEEE Std 1584™, *Guide for Performing Arc-Flash Hazard Calculations*
7. IESNA – Illuminating Engineering Society of North America
 - a. IESNA *Lighting Handbook*, Ninth Edition
 - b. IESNA RP-1, *American National Standard Practice for Office Lighting*
 - c. IESNA RP-7, *American National Standard Practice for Lighting Industrial Facilities*
8. NECA – National Electrical Contractors Association:
 - a. NECA 1, *Good Workmanship in Electrical Construction* [ANSI]
 - b. NECA 90, *Recommended Practice for Commissioning Building Electrical Systems* [ANSI]
 - c. NECA 100, *Symbols for Electrical Construction Drawings* [ANSI]
 - d. NECA 101, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)* [ANSI]
 - e. NECA 104, *Recommended Practice for Installing Aluminum Building Wire and Cable* [ANSI]

- f. NECA / NEMA 105, *Recommended Practice for Installing Metal Cable Tray Systems* [ANSI]
- g. NECA 111, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)* [ANSI]
- h. NECA / NACNA 120, *Standard for Installing Armored Cable (Type AC) and Metal-Clad Cable (Type MC)*[ANSI]
- i. NECA 202, *Recommended Practice for Installing and Maintaining Industrial Heat Tracing Systems* [ANSI]
- j. NECA 230, *Standard for Selecting, Installing and Maintaining Electric Motors and Motor Controllers* [ANSI]
- k. NECA 331, *Standard for Building and Service Entrance Grounding and Bonding*
- l. NECA 400, *Standard for Installing and Maintaining Switchboards* [ANSI]
- m. NECA 402, *Standard for Installing and Maintaining Motor Control Centers* [ANSI]
- n. NECA / EGSA 404, *Standard for Installing Generator Sets* [ANSI]
- o. NECA 407, *Recommended Practice for Installing and Maintaining Panelboards* [ANSI]
- p. NECA 408, *Recommended Practice for Installing and Maintaining Busways* [ANSI]
- q. NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers* [ANSI]
- r. NECA 410, *Recommended Practice for Installing and Maintaining Liquid-Filled Transformers* [ANSI]
- s. NECA 411, *Recommended Practice for Installing and Maintaining Uninterruptible Power Supplied (UPS)* (ANSI)
- t. NECA 420, *Standard for Fuse Applications* [ANSI]
- u. NECA 430, *Standard for Installing Medium-Voltage Metal-Clad Switchgear* [ANSI]
- v. NECA / IESNA 500, *Recommended Practice for Installing Indoor Lighting Systems* [ANSI]
- w. NECA / IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems* [ANSI]
- x. NECA / IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems* [ANSI]
- y. NECA / MACSCB 600, *Recommended Practice for Installing and Maintaining Medium-Voltage Cable* [ANSI]
- z. NECA / NEMA 605, *Installing Underground Nonmetallic Utility Duct* [ANSI]
- 9. NEMA – National Electrical Manufacturers Association
- 10. NETA – International Electrical Testing Association, Inc.:
 - a. NETA ATS, *Acceptance Testing Specifications for Electircal Power Distribution Equipment and Systems*
 - b. NETA MTS, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - c. NETA ETT, *Standard for Certification of Electrical Testing Technicians* [ANSI]
- 11. NFPA – National Fire Protection Association:

- a. NFPA 20®, *Standard for the Installation of Stationary Pumps for Fire Protection*®
- b. NFPA 70™, *National Electrical Code*® (NEC®)
- c. NFPA 70E, *Standard for Electrical Safety in the Workplace*.
- d. NFPA 101®, *Life Safety Code*®
- e. NFPA 110, *Standard for Emergency and Standby Power Systems*
- f. NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*
- g. NFPA 780, *Standard for the Installation of Lightning Protection Systems*
- h. All other NFPA codes and standards except NFPA 5000
- 12. OSHA – Occupational Safety and Health Administration
- 13. IECC – International Energy Conservation Code
- 14. ISO – International Organization for Standardization
- 15. Virginia State Energy Conservation Code
- 16. Applicable County and Municipal Codes

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, elevator equipment, and all other devices / appliances requiring electrical power. It is the intent of the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage and that all HVAC, elevator equipment and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.
- C. It is the responsibility of the Contractor to review the construction drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and all other drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.
- D. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.
- E. No proposal shall be accepted which specifically excludes any of the provisions of paragraphs B, C, or D above.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic PDF and AutoCAD 2014 and / or Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
1. 3 sets of electronic AutoCAD (2014 dwg) and / or Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 2. One reproducible Dayrex Mylar film positive of each contract as-built drawing.
 3. Three sets of blue-line prints of each contract as-built drawing.
 4. Three sets of pdf prints of each contract as-built drawing on CD.
- C. As-Built Drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
 2. Remove Engineer's Seal, name, address, and logo from drawings.
 3. Mark documents RECORD DRAWINGS.
 4. Clearly indicate: DOCUMENT PRODUCED BY:
 5. Indicate all changes to construction during construction. Indicate actual routing of all conduits, etc. that was deviated from construction drawings.
 6. Indicate exact location of all underground electrical raceways, and elevations.
 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 9. Exact location of all electrical equipment in building. Label panel schedules to indicate actual location.
 10. Exact location of all electrical equipment in and outside of the building.
 11. Exact location of all outdoor lighting and equipment.
 12. Location, size and routing of all feeder conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 13. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 14. Cloud all changes.
 15. Update all panel schedules with all additional circuits added or deleted through construction. Identify each circuit to include all information specified for directory cards for circuit identification in panelboards.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 - 1. Make final electrical connections to all electrically operated equipment indicated on the drawings, except as noted.
 - 2. The responsibility for alignment of motor and driven equipment is specified in the related division.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or

omissions in material, equipment or workmanship. Replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, materials, energy efficiency characteristics (where applicable) and lighting performance characteristics (where applicable) equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.15 OPERATING TESTS

- A. After all electrical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling

of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

- B. Notify Owner's Commissioning Authority (CxA) prior to performing any tests to the CxA may witness test at his/her discretion. Refer to Section 260100 Commissioning of Electrical Systems.

1.16 WARRANTIES

- A. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, normal freight / shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service calls required to diagnose and correct warranty problems.
- B. Manufacturer's warranty shall be from one year from date of substantial completion. Contractor shall be responsible for extending the warranties regardless of date of installation or commissioning.
- C. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.17 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager Job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.18 TEMPORARY FACILITIES

- A. General: Refer to Division 1 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 IDENTIFICATION OF EQUIPMENT

A. Identification of Equipment:

1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions. All panels, cabinets, or equipment requiring 120 volt or higher power shall be labeled as required which includes circuit designation and circuit panelboard location, regardless of which discipline installs the equipment.
2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit breaker, transfer switches, remote generator transfer devices not installed inside light fixtures, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack, security panels, time clocks, BMCS cabinets, sound reinforcement cabinets and racks, miscellaneous control cabinets, equipment integral disconnect switches, toggle or motor switches, disconnects for equipment, exterior junction boxes, exterior pull boxes, exterior wireways and gutters, and rooftop equipment (i.e.: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.
 - a. Utility Power: White letters on black background
 Generator Power (White letters on red background
 UPS Power: White letters on blue background
 Load Bank Circuits: White letters on green background
 Solar or Wind Power Generation: White on orange background
 - b. Identifying nameplates shall have 1/2-inch high, engraved letters for equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: "PANEL HA –fed from MDP-6 located in Mech. Rm. 100"). The words "fed from" and "located" shall be included in the labeling.
 - c. Each switchboard, distribution panel, transfer switch, generator transfer device (GTD) for emergency lighting, and motor control center feeder or branch circuit device shall have a nameplate showing the load and location of load served in 1/4-inch high, engraved letters. Circuit breaker name and kirk key designation if applicable
 - d. Each section of multiple section panelboards shall also indicate panelboard section number (i.e.: Panel "HA-Section 2 – fed from MDP-6 located in Mech. Rm. 100")
 - e. Motor Controllers, starters, and contactors: Provide neatly typed label inside each motor controller and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating.
 - f. Individual motor controller and contactor nameplates shall include load served, location of load served, panel and circuit numbers serving load, location of panel serving load, panel and circuit number serving control circuit, location of panel serving control circuit (if different from panel serving load), description and location (if applicable) of control controlling contactor (i.e. Controlled: Switch in RM 100, and Controlled: BMCS). Contactor nameplate is to include whether it is a lighting or receptacle contactor and name of contactor. i.e. C-1.

Lighting Contactor Example	Receptacle Contactor Example
Lighting Contactor C1 West Parking Lot Pole Lights Fed From Panel HA-2,4,6 Located Main Elec. Rm. 100 Control Circuit-Panel LA 42 Located Main Elec. Rm. 100 Controlled-BMCS	Receptacle Contactor C2 Table Recpts Lab Rm 100 Fed From Panel LA-2,4,6,8 Located Mech. Rm. 110 Control Circuit-Panel LA-42 Controlled-Emer Shut Off Mushroom Switch Rm 101

- g. Exterior J-boxes, pull boxes, and gutters shall have panel identification, circuit numbers, and location of panel listed on name plate. Low voltage shall be identified per contents, examples: DATA, BMCS, F/A
 - h. Name plates on equipment served from switchboards, distribution panels, I-Line panels, and motor control centers are not to include circuit numbers shown on drawings as the circuit numbers are for construction drawing purposes only.
 - i. Panel names for 277/480v shall start with the letter “H” and 120/208v, 120/240v shall start with the letter “L”. No panel shall be named to include a number other than multi sectional panels, example HA-section 2. New panels installed in renovation or site additions shall have names approved or designated by Owner’s electrical representative. Panel names shall not include the letter “I”. Transformer names shall start with the letter “T” followed by the panel name it serves, i.e. TLA.
 - j. Above ceiling lighting control relay equipment: Provide name plate glued to bottom of ceiling T-grid below relay location. White letters on black background with ¼” high letters on ½” tall label for digital lighting module “DLM”.
3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as “corridors”. Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect’s final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.
 4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
 5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or

enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner's motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.

- B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.
- E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red for 50 volts or above electrical, or orange for communications and control with suitable warning legend describing buried electrical lines; telephone lines and data lines per APWA recommendations. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.

3.2 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.3 INSTRUCTION OF OWNER'S PERSONNEL

- A. The Owner shall provide a list of personnel to receive instructions, and shall coordinate their attendance at the agreed upon times.
- B. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- D. Demonstrate equipment functions (both individually and as part of the total integrated system).
- E. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- F. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- G. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.4 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.5 HOUSEKEEPING PADS

- A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.
- B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.
- C. Concrete pads:
 - 1. 6-inches thick minimum indoors; 8-inches thick minimum outdoors or match existing if indicated on the drawings to extend existing pads, or in other sections of the specifications.
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
 - 5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.

2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.9 COORDINATION OF BRANCH CIRCUIT OVERCURRENT AND PROTECTION DEVICES

- A. Review with equipment specified which requires electrical connections. Review equipment shop drawings and manufacturer's nameplate data and coordinate exact branch circuit overcurrent protective device and conductors with equipment provided.
 1. Provide equipment manufacturer's recommended overcurrent protective device indicated on nameplate at no additional cost to the Owner.
 2. If branch circuit conductors and / or conduit sizing is less than the minimum required by equipment manufacturer, notify the Architect / Engineer immediately, prior to rough-in.
 3. If equipment manufacturer is a substitution to the specified equipment manufacturer, provide the greater of the conductors specified or those required for the installed equipment manufacturer's minimum circuit conductors, at no additional cost to the Owner.
 4. If conductors indicated on plans are in excess of that permitted by equipment manufacturer, notify Architect / Engineer immediately, prior to rough-in.
 5. If conductors indicated on plans are in excess of that permitted by the equipment manufacturer, provide the maximum conductors permitted by the equipment manufacturer based on NEC ampacity tables, either in a single set, or as a set of parallel conductors as permitted by the NEC. Conductor size and quantity entering the equipment enclosures shall not exceed the equipment manufacturer's maximum recommendations.

3.10 FAULT CURRENT AND OVERCURRENT DEVICE COORDINATION AND ARC FLASH STUDY

- A. Contractor shall provide a coordination study, fault current analysis, and Arc-Flash study report for new electrical distribution equipment downstream to the last new overcurrent device in each feeder or branch circuit, conducted and prepared by the switchgear manufacturer. The coordination study and fault current analysis shall include the manufacturer's recommendations for all adjustable overcurrent devices specified or provided. Study does not require inclusion of existing switchgear, except it shall include existing or new overcurrent devices in existing switchgear serving new switchgear. Contractor shall submit the report results prior to submitting switchgear submittals to allow changes or modifications to equipment selection.
- B. Contractor shall adjust all overcurrent device settings based on manufacturer's recommendations, or as directed by Owner / Architect at no additional cost to Owner. Settings for GFI shall be set at maximum as permitted by the NEC.
- C. Arc-Flash & Shock-Hazard Warning Labels: Provide arc-flash and shock hazard-warning labels that comply with ANSI Z535.4 on switchgear, switchboards, transformers, motor control centers, panelboards, motor controllers, safety switches, industrial control panels and other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. On renovation projects, install arc-flash warning labels on existing equipment where lock-out / tag-out will be required for the renovation work. Provide the information listed below on each label. Specify that arc-flash warning label information be produced by the electrical equipment manufacturer or supplier as a part of the final power system studies to be submitted by the Contractor in accordance with the electrical acceptance testing.
 1. Note: In addition to the final arc-flash analysis, the final power system studies include load flow and fault-current calculations, and an overcurrent protective device (OCPD) coordination study based on the actual equipment to be installed for the project.
- D. Information to be determined and applied to electrical equipment:
 1. Arc-Flash Protection Boundary
 2. Arc-Flash incident energy calculated in accordance with IEEE Std 15841TM
 3. Working distance calculated in accordance with IEEE Std 1584aTM
 4. NFPA 70E Hazard / Risk Category Number or the appropriate personal protective equipment (PPE) for operations with doors closed and covers on.
 - a. Typical operations include operating circuit breakers, fused switches, and meter selector switches.
 5. System phase-to-phase voltage
 6. Condition(s) when a shock hazard exists (e.g. "With cover off")
 7. Limited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 8. Restricted Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 9. Prohibited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 10. Unique equipment designation or code (described under "Component Identification"
 11. Class for insulating gloves based on system voltage (e.g., Class 00 up to 500V)

12. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000V)
 13. Date that the hazard analysis was performed.
 14. “Served from” circuit directory information including the serving equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 15. If applicable, the “serves” circuit directory information including the served equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 16. An abbreviated warning label may be used where it has been determined that no dangerous arc-flash hazard exists in accordance with IEEE 1584aTM, paragraph 9.2.3.
 17. Use a “DANGER” label where the calculated arc-flash incident energy exceeds 40 cal/cm.
- E. Submittals: Submit four copies of coordination study and certified fault current study results to the Architect for review.

3.11 EQUIPMENT BACKBOARDS

- A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each new telephone equipment terminal location.
 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each new data / voice / video / communications equipment location / cable TV head end equipment, or security equipment location.

3.12 TESTING

- A. The contractors for the various sub-systems shall submit proposed testing procedures for their systems, subject to review and approval and Owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.
- B. The project will not be declared substantially complete until the following has taken place.
1. The “As-Built” drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner’s Construction Representative.
 2. The building emergency lighting system and other systems including but not limited to those listed below have been tested, completed factory start-up and programming and adjusting as required for a complete and fully operational system acceptable to the Architect and Owner.
 3. Occupancy Sensor and Lighting Controls
 4. Surge protective device equipment
 5. Overcurrent devices
 6. Emergency Lighting
 7. Building Fire Alarm System
 8. Clock System
 9. Building Data / Voice Cabling System

10. Surveillance and Security System

3.3 LOAD BALANCING

- A. Balance the loads on each low-voltage feeder so that the voltage on each phase is within +/- 1.0% of the average voltage of the three phases. Refer to the DOE Office of Industrial Technologies, “Motor Tip Sheet #7” dated September 2005 available for download to PDF format at no charge at:
http://www1.eere.energy.gov/industry/bestpractices/pdfs/eliminate_voltage_un_balanced_motor-systems7.pdf

END OF SECTION

SECTION 260505 - ELECTRICAL ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Inspection and service of existing equipment and materials to remain or be reused.
- B. Handling of equipment and materials to be abandoned.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Contractor prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that there exist conditions and devices that are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractors responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Notify the Architect / Engineer, in writing, accordingly.

- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect / Engineer, in writing.
- C. Verify field measurements and circuiting arrangements.
- D. Verify that abandoned wiring, panelboards, and switchboards, disconnect switches, and equipment serve only abandoned facilities. Where abandoned wiring, panelboards, switchboards, and equipment which serve existing facilities are to remain, Contractor shall provide means and methods to ensure existing facilities remain energized with the correct voltage, overcurrent protection, conductors, and circuit ampacity required by the existing facilities to remain.
- F. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specification to be reused shall be cleaned and reconditioned, including tightening of feeder and bus bar lugs prior to installation and reuse in the modified system.
- B. Remove existing luminaries for alterations/renovations. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. For each luminaire that is taken down for alteration and then reinstalled, replace damaged parts, provide new lamps and, with matching paint, touch-up scratched or abraded areas, and replace cracked, broken or missing lenses or diffusers. Replace unrepairable fixtures with new fixtures
- C. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and shall be removed from the site.
- D. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- E. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner.
- F. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Panelboards Reused and Modified for Renovation: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.3 SEQUENCING AND SCHEDULING

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.
- C. Prior to shutdown of existing power for any single extended period of time greater than 18 hours, provide at minimum 120/240 volt, 1-phase, 3-wire electrical service to provide temporary power to all critical loads as identified by Owner including but not limited to all security systems, fire alarm panel and associated remote power supplies. Contractor shall provide continuous operation temporary generator power or coordinate directly with local utility regarding temporary power service and metering and provide all necessary permits and fees at no cost to the Owner.
- D. Provide a minimum 30 space panelboard with required branch circuit breakers as required and all associated temporary wiring as required. Remove all temporary power prior to substantial completion.
- E. Existing Electrical Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain written permission from Owner at least 10 business days before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Disclose the extent, exact time and expected duration of the outage in a written request to the Owner.
- F. Remove and replace existing conduit, wiring, outlets, devices, lighting fixtures, panels and appurtenances as occasioned by new or remodeled construction. Re-establish service to lights, switches and devices that may be interrupted by remodeled construction.
- G. Disconnect electrical systems in walls, floors and ceilings scheduled for removal. When outlets are removed, wire shall be pulled out of the conduit back to the nearest remaining box or cabinet.
 - 1. Remove exposed conduit that has been abandoned.
 - 2. Cap conduit beyond the finish line.
 - 3. Provide unswitched circuit leg for emergency battery powered equipment; circuit from same branch circuit breaker as switched normal lighting circuit.
- H. Where new/existing luminaries or devices are shown being connected to existing circuits:
 - 1. Field verify existing system voltage
 - 2. Provide ballast / device to match system voltage
- I. Verify the loading of each circuit affected by remodeling work. The maximum load of any branch circuit shall not exceed 80% of its rating.

- J. Remove equipment, systems, conductors, wiring, raceways, etc. abandoned or not required for existing or new systems. Coordinate with Architect / Owner for salvage by Owner. Remove abandoned / not required raceways and wiring back to nearest box serving load to remain, or back to panel if not serving remaining load.
- K. Existing Power, and Lighting and Appliance Branch Circuit Distribution System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- L. Existing Lighting System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- M. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- N. Existing Data Network: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- O. Existing Security System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- P. Existing Video Surveillance System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
 - 1. Remove abandoned electrical distribution equipment, utilization equipment,

- outlets and accessible portions of wiring, raceway systems, and cables back to the source panelboard, switchboard, switchgear, communications closet, or cabinet. Abandoned wiring and raceways can result from actions that include the following:
- a. Equipment is removed or relocated
 - b. Fixtures are removed or relocated
 - c. System is no longer used
 - d. There is no demonstrable near term future use for the existing circuit or raceway system.
2. Leave abandoned electrical equipment, conductors, and material in place only if one or more of the following conditions exist:
 - a. The removal requires the demolition of other structures, finishes, or equipment that is still in use. An example is abandoned conduit above an existing plaster ceiling.
 - b. Removal is not feasible due to hazards, construction methods, or restricted access.
 - c. Removal of abandoned conductors may damage conductors that must remain operational.
 3. Remove conduits, including those above accessible ceilings, to the point that building construction, earth, or paving covers them. Cut conduit beneath or flush with building construction or paving. Plug, cap, or seal the remaining unused conduits. Install blank covers for abandoned boxes and enclosures not removed.
 4. Extend existing equipment connections using material and methods compatible with the existing electrical installation and this division.
 5. Restore the original fire rating of floors, walls, and ceilings after electrical demolition.
 6. Use approved lock-out / tag-out procedures to control hazardous energy sources. Assure that an electrically safe work condition exists in the demolition area before beginning demolition. Where possible, disconnect the building from all sources of electrical power before beginning demolition.
- B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.
- D. Conduit and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Conduit and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in

such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.

- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed. Replace existing wiring devices and cover plates with new wiring devices and new cover plates in renovated areas. Any corridor, room, or area indicated to have any new wiring devices installed shall have all of the existing wiring devices and cover plates replaced with new wiring devices and new cover plates.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- K. Existing conduit raceway found to need additional hangers installed and/or junction box covers shall be added at no additional cost to the Owner.
- L. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new, typed panel directory cards (and card holders if needed) for existing panelboards located within the renovated areas. Ring out all new and existing circuits within these panelboards as specified in Section 260500 Electrical General Provisions. Do not include the description "existing". Provide new nameplates for all existing electrical equipment in renovated areas as specified in Section 260500

Electrical General Provisions.

3.7 TESTING AND CORRECTIVE MEASURES FOR DAMAGE DURING CONSTRUCTION IN EXISTING LOW VOLTAGE SYSTEMS

- A. Pre-construction testing of existing low voltage systems:
 - 1. Provide a complete operational test of the following systems prior to demolition and renovation. Verify operation of each circuit, device, panel, console, distribution equipment, and associated accessories. Test shall be performed by a contractor and technicians, each certified by the respective manufacturer of the existing special system to perform test, programming, and repairs to the respective manufacturer's system. Testing of the existing system shall include all areas served by the existing system including but not limited to the main campus, remote buildings, and temporary buildings:
 - a. Fire Alarm System
 - b. Data Network Communications System
 - c. Security Access Control System
 - 1. Provide a complete written report to the Architect, indicating any deficiencies of the existing system in relation to each component's intended function. Include in the written report evidence of current certification by the respective manufacturer for the contractor and individuals performing the tests. Provide the written report within 14 days of notice to proceed and prior to any demolition or renovation work.
- B. Substantial completion testing of existing low voltage systems:
 - 1. Provide complete operational tests of the following systems within 14-days prior to estimated date of substantial completion. Verify operation of each circuit, device, panel, console, distribution equipment, and associated accessories. Test shall be performed by a contractor and technicians each certified by the respective manufacturer of the existing system to perform test, programming, and repairs to the respective manufacturer's system. Testing of the existing system shall include all areas served by the existing system including but not limited to the main campus, remote buildings, and temporary buildings:
 - a. Fire Alarm System
 - b. Data Network Communications System
 - c. Security Access Control System
 - 2. Provide a complete written report to the Architect, indicating any deficiencies of the existing system in relation to each component's intended function. Include in the written report evidence of current certification by the respective manufacturer for the contractor and each individual performing the tests. Provide the written report within 14 days of expected date for substantial completion.
- C. Repairs, equipment replacements, and corrections to low voltage systems due to damage caused by contractor:
 - 1. Notify the Owner immediately of any disruption or damage to any low voltage system.
 - 2. Any disruption or damage to the existing access control system or fire alarm system shall be corrected the same day as the disruption or damage occurred. The access control system and fire alarm system shall be tested daily in the presence of the owner prior to the Contractor leaving the job site each day.

3. For each low voltage system other than access control or fire alarm system, a manufacturer certified contractor and certified technicians shall perform corrective measures to each system component that was functional prior to demolition and renovation and found defective or non-functional within 14-days prior to estimated date of substantial completion.
4. Corrective measures to all low voltage systems to correct components of the low voltage systems found damaged by the contractor shall be completed to the satisfaction of the Owner and Architect / Engineer prior to acceptance of substantial completion at no additional cost to the Owner.

END OF SECTION

SECTION 260509 - ELECTRIC UTILITY COORDINATION AND SERVICE ENTRANCE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. General: Electrical service shall be provided by local utility company.
- B. Power Company Data: Obtain from utility company information and installation standards for electrical service installation.
- C. Responsibilities: Determine what equipment and labor is provided by utility company and what equipment and labor is required of this Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Service Data: Ensure that utility company service data is accurate and verified.

2.2 PRIMARY SERVICE

- A. General: Division 26 shall provide primary service conduit, concrete transformer pads, and pull boxes as required and as specified.
- B. Utility company shall provide primary cables, splices, terminations, and primary underground and overhead service conductors.

2.3 TRANSFORMERS AND SWITCHGEAR

- A. General: Division 26 shall make provisions for service as required by utility company, including, but not limited to permanent or removable/lockable vehicular barriers, grounding rods, grounding conductors, and sleeves.
- B. The utility company shall provide service transformers, primary switchgear, primary protective relaying, and connections to the customer service.

2.4 SECONDARY SERVICE CONDUCTORS

- A. General: Division 26 shall provide secondary service entrance conductors and conduits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Standards: The installation of the service entrance provisions shall comply with the published standards and requirements of the utility company, the utility company's specific construction requirements for this project, and with requirements of this Division.

- B. Correction: Any failure to meet the standards and requirements shall be corrected to the satisfaction of the utility company and Owner without any additional cost to the Owner.
- C. Contractor shall provide all construction materials and labor that the utility company determines to be the responsibility of the customer, at no additional cost to the Owner.
- D. The materials and labor required by the for a complete installation shall be provided by the contractor and includes but is not limited to permanent or removable / lockable vehicular barriers, grounding rods, grounding conductors, sleeves, concrete pads, conduits, metering racks and metering enclosures.
- E. Utility distribution poles and service entrance locations shall be staked and surveyed prior to pole installation by the Contractor to verify their proper placement is within the Owner's property and respective utility easements. Contractor shall verify by survey that the pole and service entrance location and easements do not interfere with existing easements, right-of-ways, or other restricted properties. Conflicts with existing easements and restrictions shall be brought to the attention of the Architect prior to construction.
- F. Contractor shall initiate contact with the power provider (retail seller), utility (transmission and distribution), and Owner within 14 days of Notice to Proceed to ensure permanent power will be available to the site. Any delays resulting from lack of this coordination shall be the responsibility of the Contractor.

END OF SECTION

SECTION 260512 - SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1 and as outlined below.
- B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.
- C. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- D. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 ARCHITECT/ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect/Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.3 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Division 1.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.1 SPECIFICATION COMPLIANCE REVIEW

- A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

3.2 SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal.
- B. Submittal Specification Information:
 - 1. Every submittal document shall bear the following information as used in the project manual:
 - a. The related specification section number
 - b. The exact specification section title
 - 2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.
- C. Submit individually bound shop drawings and product data for the following when specified or provided. The Fault Current and Overcurrent Device Coordination Analysis shall be submitted prior to other switchgear.
 - 1. Fault Current and Overcurrent Device Coordination Analysis.
 - 2. Enclosed Switches and Circuit Breakers
 - 3. Enclosed Motor Controllers
 - 4. Panelboards and enclosures
 - 5. Wiring devices
 - 6. Motor control centers
 - 7. Electrical controls and time switches
 - 8. Lighting fixtures
 - 9. Site Lighting, Fixtures, Drivers, and Lamps
 - 10. Architectural Dimming Systems
 - 11. Surge Protection Devices
 - 12. Electrical Contactors

13. Lighting Controls and Occupancy Sensors
14. PVC Coated galvanized steel conduit and fittings
15. RTRC conduit and fittings
16. Transformers
17. Switchboards
18. Electrical cable trays
19. Sports Lighting Equipment and Fixtures
20. Surface Raceways
21. Fire Rated Cables and Connectors

3.3 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relation to adjacent or critical features or work or products.

3.4 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name; identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each room containing major electrical switchgear and each outside equipment pad with major electrical switchgear and equipment, submit plan and elevation drawings. Show:
 1. Actual electrical switchgear, equipment and components to be furnished.
 2. NEC working space and NEC access to NEC working space.
 3. Relationship to other equipment and components provided by other trades, ductwork, piping, air-handling equipment, etc., and openings, doors and obstructions. Drawings shall include an overlay of other systems demonstrating coordination and clearances.
 4. Housekeeping pad location and dimensions
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Verify location of wiring devices, telephone outlets and other work specified in this Division.
 1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.

2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.
- F. Submit shop drawings in plan, elevation and sections, showing receptacles, outlets, electrical and telecommunication devices in casework, cabinetwork and built-in furniture.

3.5 PRODUCT DATA

- A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

3.6 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

3.7 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 1. Field measurements
 2. Field construction criteria
 3. Manufacturer's catalog numbers
 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect/Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect/Engineer reviews submittals or not.

- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations identified by the Contractor on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed by the Contractor for processing or for making corrections for re-submittal.
- J. Contractor's Stamp of Approval
 - 1. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
 - 2. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
 - 3. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
 - 4. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

3.8 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor. Product and equipment related to site work or other trades which require extensive rough-in, foundations, or structural support shall be submitted as soon as possible after given notice to proceed with construction.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one electronic data file (pdf) and three opaque reproductions.
 - 2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer, and/or electronic data (pdf) files.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and telephone number

4. The number of each Shop Drawing, Project Datum and Sample submitted
 5. Other pertinent data
- D. Submittals shall include:
1. The date of submission
 2. The project title and number
 3. Contract Identification
 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 5. Identification of the product
 6. Field dimensions, clearly identified as such
 7. Relation to adjacent or critical features of the work or materials
 8. Applicable standards, such as ASTM or federal specifications numbers
 9. Identification of deviations from contract documents
 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 2. Associable items requiring correlation for efficient function or for installation

3.9 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals. Re-submittals shall be a complete submittal as if it were the initial submittal unless otherwise instructed in the review comments on the original submittal.
1. Indicate that the document or sample is a resubmittal
 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

END OF SECTION

SECTION 260516 - EXCAVATING, BACKFILLING AND COMPACTING FOR ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 apply to this section.
- B. Refer to Instructions for substitution of materials and products.
- C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

- A. Coordinating all excavating and backfilling for the electrical underground, and all related appurtenances.
- B. The extent of raceways, excavation, and backfill shall be in conformance with the locations, raceways, elevations and grades shown on the drawings.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM) Use current edition.
 - 1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
 - 2. ASTM D1556, Standard Test method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - 3. ASTM D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
 - 4. ASTM D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- B. Local Authority Having Jurisdiction Standards
- C. Local Governing Agencies or Utilities

1.4 WARRANTY

- A. Provide written warranty against defects in the material and workmanship for the work of this Section for a period of one year from the Date of Substantial Completion of the Project. Refer to Division 1 for Warranty form.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Cement-Stabilized Sand: Clean, local sand mixed with not less than 1-1/2 sacks of Portland cement per ton; mix in a mill-type mixer.
- B. Sand: Clean, local sand
- C. Earth Backfill: Clean local material consistent with the surrounding earth material and free of large clods, roots, organic materials, rocks or other debris.

PART 3 – EXECUTION

3.1 EXCAVATION

- A. General:
 - 1. All utility trenches shall be constructed in conformance with OSHA trench safety standards.
 - 2. Sheet piling and shoring shall be accomplished to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period for trenches five feet in depth or deeper. Where approved, trench sides may be laid back in lieu of shoring to meet OSHA safety standards.
 - 3. Utilities shall not be constructed or laid in a trench in the presence of water. All water shall be sufficiently removed from the trench prior to the raceway placing operation to ensure a dry, firm bed on which to place the raceway.
- B. Appurtenances:
 - 1. Any overdepth excavation below appurtenances shall be refilled with cement-stabilized sand.
- C. Electrical Trenches:
 - 1. Electrical underground raceways must be the minimum depth required by the local governing authority and Power Company.
 - 2. Trench width for the electrical raceway shall be a minimum of the outside raceway encasement plus 12 inches.
 - 3. Trenches shall be excavated to a depth of at least 6 inches below the conduit raceway. The conduit raceway bedding and concrete encasement, if required, shall then be placed in accordance with the local governing authority and Power Company standard details.

3.2 BEDDING AND BACKFILL

- A. Electrical Trenches:
 - 1. Place backfill, consisting of sand or cement stabilized sand, to a depth of one foot above top of raceway or concrete duct bank and compact to 90% maximum density.

2. Backfill the remainder of the trench in 6 inch lifts with select excavated material and compact as required to achieve density of soil of surrounding area.
- B. Utility Locators:
1. Provide metallic locators for utility company raceways as required by respective utility.
 2. Refer to other specification sections for additional requirements for underground raceway locators and markers.

END OF SECTION

SECTION 260519 – CONDUCTORS & CONNECTORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide electrical conductors, wire and connector work as shown and specified.
- B. Types: The types of conductors and connectors required for the project include the following:
 - 1. 600V building conductors
 - 2. 600V building conductor connectors
- C. Application: The applications for conductors and connectors required on the project are as follows:
 - 1. Power distribution circuitry
 - 2. Lighting branch circuitry
 - 3. Appliance, receptacle, and equipment branch circuitry
 - 4. Motor branch circuitry
 - 5. Control wiring
 - 6. Line voltage
- D. Refer to other specific specification sections for voice, data, alarm and instrumentation cables.

1.2 QUALITY ASSURANCE

- A. UL Label: Conductors and connectors shall be UL labeled.

1.3 REFERENCES

- A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CONNECTORS

- A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.
- B. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
 - 1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.

2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.
- C. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.
 1. All wiring inside lighting fixtures shall be temperature rated per NEC.
 2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.
- B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.
- C. Conductors:
 1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
 2. No more than six phase conductors shall be installed in a single raceway.
 3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
 4. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
 5. When more than three (3) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
 6. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
 7. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
 8. For 15 and 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
 9. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
 10. Do not install a pull string in conduits containing conductors.
 11. Neutral conductors shall be full-size and shall not be reduced in size under any circumstances.

- D. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.
- E. Splices and Joints:
 - 1. In accordance with UL 486A, C, D, E, and NEC.
 - 2. Aboveground Circuits (No. 10 AWG and smaller):
 - a. Connectors: Solderless, screw-on, reusable pressure cable type rated 600 V, 220° F, with integral insulation, approved for copper and aluminum conductors.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
- F. Aboveground Circuits (No. 8 AWG and larger):
 - 1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
 - 2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
 - 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
 - 4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

3.2 TESTING

- A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.

END OF SECTION

SECTION 260527 - EXPANSION OF EXISTING ELECTRICAL GROUNDING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code
 - 2. Governing local codes
 - 3. Local Utility Company
- B. Ground effectively and permanently.
 - 1. Verify existing neutral conductor bonding at the main service disconnect and at other new/relocated or reused separately derived systems.
 - 2. Verify grounding for relocated main service equipment, CT cabinet, and main disconnect.
 - 3. All new/relocated conduit or cable tray systems
 - 4. All new/relocated electrical equipment and related current carrying supports or structures
 - 5. All new / relocated metal piping systems
 - 6. Ensure proper grounding for the new utility transformer dedicated to the fire pump system.
 - 7. All new building structural metal frames

1.2 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. Cadweld

- C. Burndy
- D. O.Z. Gedney
- E. Crouse-Hinds
- F. B-Line

2.2 GROUNDING ELECTRODES

- A. Driven Rod Electrode
 - 1. 3/4" x 10'-0" copper clad grounding electrode, UL listed
 - 2. UL listed grounding electrode connector
 - 3. Approved thermal fusion methods (exothermic)
- B. Metal Frame of Building
- C. Existing grounding electrode system to be verified and modified as need for relocated main service equipment.

2.3 DRIVEN ELECTRODE ACCESS BOX AND COVER

- A. Tier 22 Hubbell Tier 22 CDR 20-inch round enclosure.
- B. Provide Tier 22 bolt down traffic rated cover with "GROUND" embossed on top.

2.4 MATERIALS AND COMPONENTS

- A. Reference other sections of this specifications for materials specified there.
- B. Heavy-duty, copper, two bolt type, copper alloy or bronze compression lugs for grounding and bonding applications, in configurations required for particular installation.

PART 3 - EXECUTION

3.1 SYSTEMS 600 VOLTS OR LESS

- A. In the existing service equipment, field verify existing condition of ground bus.
 - 1. Field verify existing bond of the ground bus to the existing service grounding conductor, to the neutral bar.
 - 2. Tighten existing ground lugs and connections.
- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
 - 1. In rigid PVC conduit.
 - 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
 - b. Install rod electrodes as indicated. Install additional rod electrodes as

- required to achieve specified resistance to ground.
 - c. The minimum distance between driven ground rod electrodes shall be 10'.
 - 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
 - b. Refer to drawings for project specific ground resistance requirements.
 - 4. Provide grounding for the new utility transformer dedicated to the fire pump per NEC 250.30.
- C. Field verify the grounding electrode conductor between the ground bus and the grounding electrode systems are in compliance with the NEC.
- D. Provide an insulated grounding conductor inside all new conduits, raceways, surface raceways and cables used for power distribution. The ground wire shall be bonded to each box. All bonding jumpers shall be routed inside conduit or raceway.
- E. Provide an insulated, isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and receptacles.
- F. Provide all new/relocated conduits terminating in switchgear, transformers, switchboards, and panelboards with grounding bushings, where required and ground wire extended to ground bus in equipment.
- G. Where modifications to the main service disconnect are required, main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.
- H. Interface with lightning protection system when lightning protection system is specified.
- I. Locate and install anchors, fasteners, and supports in accordance with NECA “Standard of Installation”.
- J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- K. Do not use spring steel clips and clamps.
- L. Do not use powder-actuated anchors.
- M. Do not drill or cut structural members.
- N. Do not use compression or mechanical connectors underground.

3.2 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the building equipment grounding system shall be maintained throughout the project. Grounding jumpers shall be inside conduit, fittings and boxes and shall be

installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6', and other non-electrically continuous raceway fittings.

- B. Grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable PVC raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Provide #6 ground conductor from telephone/voice/CATV/data company demarcation point to building electrical service entrance ground electrode connection and as required by all local utility companies.
 - 1. New MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico Cadweld #B544A028 ground bar with 7/16-inch holes, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the main electrical service disconnect.
 - 2. New IDF Closets Telecommunications Ground Bar (TGB): Provide Erico Cadweld #B542A004 ground bar with 7/16-inch holes, mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel.
 - 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 - 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.
 - 5. Bond each equipment rack with #6 AWG insulated ground conductor to the TMGB / TGB.
 - 6. Route TMGB – TGB ground conductor using the shortest route practical with long radius curves.
- E. Ground new and removed/replaced lighting fixture bodies to the conduit grounding system.
- F. Receptacles: Provide a ground wire bonded to the conduit ground system, except where and insulated isolated grounding receptacle is specified.
- G. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire around flexible conduit.
- H. Provide grounding access well for each driven ground electrode, if used.
 - 1. Access well top shall be flush with finish grade.
 - 2. Provide thermal fusion (exothermic) connectors approved for direct burial.

- I. Ground all light poles and all exterior metal structures supporting conduit, switchgear, or light fixtures.
- J. Exterior Electrical Equipment Racks:
 - 1. Provide driven ground electrode for racks mounted remote from building structure.
 - 2. Where mounted on roof, ground to be building structural steel.
- K. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).

3.3 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.4 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.
 - 1. Inspect and test in accordance with NETA ATS except Section 4
 - 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13
- B. The Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The two-Point Bonding test shall be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 260533 - CONDUIT SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete system of electrical conduits and fittings.

1.2 REFERENCE STANDARDS

- A. National Electrical Code
- B. Local codes and ordinances
- C. UL
- D. ETL

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Raceways:
 - 1. Allied, International Metal Hose, Ipex, Heritage Plastics, Wheatland, Can-Tex, Carlon, Certain-Teed, Anamet, Inc., Electri-Flex Co., Western Tube and Conduit
 - 2. PVC Coated RGC: Perma Cote or Plasti-Bond, – no exceptions
 - 3. Stainless Steel: Calbrite, Gibson
 - 4. Aluminum: American Conduit/Sapa, Wheatland, Cooper B-Line, Patriot Aluminum Products
 - 5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass, United Fiberglass
- B. Fittings:
 - 1. Appleton, Crouse Hinds, Topaz, Steel City, O.Z. Gedney, Carlon, Heritage Plastics, Racor, Ipex, International Metal Hose, Lew Electric Fittings Co.
 - 2. PVC Coated ferrous fittings: Perma-cote or Plasti-Bond, – no exceptions
 - 3. Stainless Steel: Calbrite, Gibson, Crouse Hinds
 - 4. Aluminum: American Conduit/Sapa, Wheatland, Cooper B-Line, Patriot Aluminum Products
 - 5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass
- C. Condulets and Conduit Bodies:
 - 1. Appleton, Form 85
 - 2. PVC Coated: Perma-cote or Plasti-Bond, – no exceptions
 - 3. Stainless Steel: Calbrite, Gibson, Crouse Hinds
 - 4. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass
- D. Steel MC Cable for light fixture whips:

1. AFC
2. Southwire
3. General Cable
4. Kaf-Tech

2.2 GENERAL

- A. The minimum conduit size shall be $\frac{3}{4}$ -inch unless indicated otherwise in Divisions 26, 27 or 28.
 1. Branch Circuits: Minimum conduit size for dedicated outlets shall be $\frac{3}{4}$ -inch. Minimum conduit size from branch circuit panel to first outlet box of a multi-outlet branch circuit shall be $\frac{3}{4}$ -inch. Minimum conduit size from first outlet box to additional outlet boxes of a multi-outlet branch circuit where the conduit is installed above accessible ceilings or inside metal stud walls shall be $\frac{1}{2}$ -inch.
 2. Feeder Circuits: Minimum conduit size shall be $\frac{3}{4}$ -inches.
 3. Technology, telecommunications, and low voltage systems: The minimum conduit size shall be $\frac{3}{4}$ -inches unless noted or indicated otherwise.
 4. The minimum conduit size between buildings for technology, voice, data, fire alarm, video, security, surveillance, BMCS, and other telecommunications shall be 2-inch unless indicated otherwise.
- B. The minimum conduit size for flexible metallic conduit for tap connections to individual light fixtures shall be $\frac{3}{4}$ inch, or steel metal clad (MC) cable with insulated ground conductor maximum 6 feet.
- C. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing shall not be used on this project.
- D. BX and AC cable shall not be used on this project.
- E. PVC elbows shall not be used on this project.
- F. Intermediate metal conduit (IMC) shall not be used on this project.

2.3 RIGID METAL CONDUIT

- A. UL labeled, Schedule 40:
 1. Mild steel pipe, zinc coated inside and out
 2. Aluminum Alloy 6063, T-1 temper
 3. Threaded ends
 4. Insulated bushings
- B. Fittings shall meet the same requirements as rigid metal conduits.
 1. UL labeled
 2. Threaded fittings

2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. UL labeled, standard weight:
 1. Cold rolled steel tubing, zinc coated inside and out
 2. Aluminum Alloy 6005, 6063. Temper T-1

- B. Fittings shall meet the same requirements as EMT conduits.
 - 1. UL labeled
 - 2. Insulated throat connectors
 - 3. Steel fittings with setscrews with lock nuts on threaded ends, no snap locks
 - 4. Cast metal fittings are not approved
 - 5. Uni-couple type connectors are not approved
 - 6. Split ring, anti-short bushings are not approved

2.5 PVC COATED RIGID STEEL WITH URETHANE INTERIOR COATING

- A. The PVC coated galvanized rigid conduit and fittings must be ETL Listed and Verified. The PVC coating must have been investigated and verified by ETL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be ETL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed for the hazard conditions to which they are to be used. All conduit and fittings must be new, unused material. Applicable UL standards may include: UL 6 Standard for Safety, Rigid Metal Conduit, and UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.
- B. The PVC coated galvanized rigid conduit and fittings must be ETL Verified to the Intertek ETL SEMKO High Temperature H₂O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.
- C. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.
- D. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
- E. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.
- F. Form 8 Condulets, ½-inch through 2-inch diameters, shall have a tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum) for 72 hours shall be available.
- G. Form 8 Condulets shall be supplied with plastic encapsulated stainless-steel cover screws.
- H. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.
- I. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).
- J. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.

- K. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.
- L. Independent certified test results shall be available to confirm coating adhesion under the following conditions
 - 1. Conduit and conduit exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D1151)
 - 2. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
 - 3. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
 - 4. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
- M. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts shall be provided with plastic encapsulated nuts that cover the exposed portions of the threads.
- N. All fittings, clamps, straps, struts, and hardware used with PVC coated conduit shall be PVC coated or 316 stainless steel

2.6 RTRC CONDUIT FITTINGS AND CONDUIT BODIES

- A. UL listed
- B. Standard wall thickness sizes ¼-inch through 4-inch
- C. Underground medium wall thickness sizes 5 and 6-inch
- D. Conduit interface joints above grade, gasket joint below grade
- E. Extra heavy wall for above ground and/or UL Class 1 Division 2 and Class 1 Zone 2 applications.

2.7 STEEL FLEXIBLE CONDUIT

- A. Steel flexible metallic conduit:
 - 1. Zinc coated inside and out
 - 2. 18-inches minimum length, 24-inches maximum length
- B. Steel flexible metallic conduit for tap connections to light fixtures where steel MC Cable fixture whips are not used:
 - 1. 18 inches minimum length; 6 feet maximum length
- C. Liquid tight flexible steel conduit
 - 1. Type L.A. - Grounded - UL Approved
 - 2. 18-inches minimum length, 24-inches maximum length

2.8 PVC CONDUIT

- A. UL labeled Schedule 40 and Schedule 80
- B. PVC fittings and solvent welded joints
- C. Acceptable PVC conduit manufacturer: Ipex, Cantex

2.9 CONDULETS AND CONDUIT BODIES

- A. UL Labeled
- B. Form 85
- C. PVC Coated: Form 8
- D. LBC Condulets shall be used for size 2 inch and above.
- E. LL and LR Condulets shall not be used for 2 inch and above

2.10 ALUMINUM CONDUIT

- A. UL Labeled
- B. Aluminum fittings shall meet the same requirements of aluminum conduits, compatible steel fittings.
 - 1. UL Labeled for use with aluminum conduit.

2.11 STAINLESS STEEL CONDUIT

- A. UL Labeled
- B. Rigid Stainless Steel:
 - 1. Type 304 Stainless Steel
 - 2. Threaded ends
 - 3. Insulated Bushings
- C. EMT:
 - 1. Type 304 Stainless Steel
 - 2. Compression Fittings
 - 3. Insulated Bushings
- D. Fittings, elbows, nipples, strut, device box, clamps straps, etc.
 - 1. Type 304 Stainless Steel

2.12 ELECTRICAL NON-METALLIC TUBING (ENT)

- A. UL labeled Schedule 40
- B. PVC fittings and solvent welded joints

- C. Acceptable manufacture: Carlon

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electrical conduits and fittings for all wiring of any type unless specifically specified or instructed to do otherwise. Install conduits and fittings in accordance with local codes and applicable sections of the NECA “Standard of Installation”, concealed where possible.
1. Fasten conduit supports to building structure and surfaces; do not support to roof deck.
 2. Arrange supports to prevent misalignment during wiring installation.
 3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 4. Do not attach conduit to ceiling support wires.
 5. Arrange conduit to maintain head room and present neat appearance.
 6. Maintain 13-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
 7. Cut conduit square using saw or pipe cutter; de-burr cut ends.
 8. Bring conduit to shoulder of fittings; fasten securely.
 9. Conduit penetrations to all individual motor controllers, VFDs, and motor control cabinets shall only be made at the bottom of the enclosure. For other equipment, provide listed water sealing conduit hubs to fasten conduit to sides or tops of electrical equipment enclosures, device box, gutter, wireway, disconnect, etc.
 10. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
 11. Ground and bond conduit as required.
 12. Identify conduit as required.
 13. Route all conduits above building slab perpendicular or parallel to building lines.
 14. Do not use no-thread couplings and connectors for galvanized steel, PVC coated galvanized steel, or aluminum rigid conduit.
 15. MC cable shall not be used in concealed locations, including walls, ceilings, or floors. All concealed wiring shall be installed in conduit.
- B. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- C. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.
- D. Securely fasten conduits, supports and boxes, to ceiling (not roof deck), walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.
- E. Provide separate raceway systems for each of the following when specified, indicated or required:

1. 120/208 volt circuits
 2. Emergency
 3. Voice/Data
 4. Architectural Dimming Controls
 5. Communications
 6. Fire Alarm
 7. Lighting and Building Management Control Systems
- F. Unless shown otherwise, do not install conduit in or below concrete building slabs.
- G. Unless shown otherwise, do not install conduit horizontally in concrete slabs.
- H. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing. Conduit for equipment mounted on roof curbs shall be routed through the roof curb. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise. Where specifically indicated to be routed or mounted on the roof, supports shall be as specified, as recommended by roofing manufacturer and roof support manufacturer and as required by NEC. Place supports every five feet along conduit run and within 3 feet of all bends, condulets, and junction boxes. Provide roofing pad under stands at directed by Architect and as recommended by roofing manufacturer and roof support manufacturer. Provide additional unistrut supports and accessories as required.
- I. PVC coated conduit shall have all nicks and cuts to the protective coating repaired using manufacturer's approved touch-up material as recommended by manufacturer. Provide a minimum of two-wraps of 3M-50 type tape over touch-up.
- J. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit. Submit copies of training certification with submittal. Contractor shall coordinate installation with manufacturer's representative for field training and observation of installed PVC coated rigid galvanized conduit and fittings. Manufacturer's representative shall certify the installation is in accordance with manufacturer's installation instructions. Submit copies of installation certification prior to cover-up of underground installation.
- K. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
1. Provide insulated throat connectors for EMT conduits.
 2. Provide insulated bushing on all rigid conduit terminations.
 3. Provide locknuts inside and outside of all boxes and enclosures.
 4. Provide threaded type plastic bushing at all boxes and enclosures
- L. In suspended ceilings, support conduit runs from the structure, not the ceiling system construction.
1. Do not support from structural bridging.
 2. Do not support from metal roof deck.
- M. Completely install each conduit run prior to pulling conductors. All boxes are to be accessible after completion of construction.

- N. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pours.
- O. Ream ends of conduits after cutting and application of cutting die to remove rough edges.
- P. Install all above concrete slab conduits perpendicular or parallel to building lines in the most direct, neat and workmanlike manner.
 - 1. Cable Tension:
 - a. 0.008 lb./cmil for up to 3 conductors, not to exceed 10,000 pounds.
 - b. 0.0064 lb./cmil for more than 3 conductors, not to exceed 10,000 pounds
 - c. 1000 lbs. per basket grip.
 - 2. Sidewall pressure: 500 lbs./ft.
 - 3. Conduit runs within the following limits of bends and conduit length between pull points shall not exceed the above installation pulling tension and sidewall pressure limits.
 - a. Three (3) equivalent 90-degree bends: not more than fifty feet (50') between pull points.
 - b. Two (2) equivalent 90-degree bends: not more than one hundred feet (100') between pull points.
 - c. One (1) equivalent 90-degree bend: not more than one hundred fifty feet (150') between pull points.
 - d. Straight pull: not more than two hundred feet (200') between pull points.
 - 4. Indicate sizes of conduits, wireway sections, and cable tray sections on the as-built drawings.
 - 5. Hold horizontal and vertical conduits as close as possible to walls, ceilings and other elements of the building construction. Conduits shall be kept a minimum of 6 inches clear of roof deck / insulation, and 2 inches clear of above floor deck / insulation.
 - 6. Install conduits to conserve building space and not obstruct equipment service space or interfere with use of space. Conduit shall not be routed on floors, paved areas or grade.
 - 7. Where a piece of equipment is wired from a switch or box on adjacent wall, the wiring shall go up the wall from the box, across at or near the ceiling, and back down to the equipment. Wiring shall not block the walkway between wall and equipment.
 - 8. Horizontal runs of conduit on exposed walls shall be kept to a minimum.
 - 9. Conduit for mechanical / plumbing equipment installed outdoors shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.
 - 10. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks to bottom of roof deck or floor deck. Conduits shall be grouped for neat workman-like appearance.
- Q. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-feet maximum, on center, on straight runs which exceed 400-feet, and where conduits cross building expansion joints.
- R. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.

- S. Run conduit to avoid proximity to heat producing equipment, piping, and flues, keeping a minimum of 13-inches clear.
- T. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in a manner to ensure a tight joint. Fasten the entire conduit system into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting.
- U. Conceal conduit systems in finished areas. Conduit may be exposed in mechanical and electrical rooms, and where otherwise shown or indicated only. Run the conduit parallel and perpendicular to the structural features of the building and support with malleable iron conduit clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners.
- V. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing. Conduit hanger spacing shall be 10 feet or less and as required by the NEC for all conduit. Beam clamp attachments to steel joist chords is prohibited. Beam clamps may only be used at beams, no exceptions. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.
- W. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Where rod pendants are not used, channel supports are to be secured to structure at each end. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt "wings" are not acceptable. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt and nut and threaded rod. Raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas. Do not support conduit from other conduit, structural bridging or fire rated ceiling system. Do not support more than one conduit from a single all-thread rod support. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners. Channel supports shall have cut ends filed smooth. When installed outside of the building, or in areas subject to moisture, the cut ends shall be painted with ZRC galvanized paint or equivalent.
- X. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with "Tee" conduit at motor outlet height for flexible conduit.
- Y. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers. Tie wire and short pieces of conduit used as supports and or hangers are not approved.
- Z. Where "LB" condulets are used, 2-inches and larger shall be type "LBD".

- AA. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.
- BB. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to equipment, light fixtures, power poles, etc. They are not to be used in lieu of conduit runs. They shall not be used for wall or roof penetrations unless they are installed in a PVC coated RGC conduit sleeve at least one size larger than the OD of the flexible conduit.
- CC. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.
- DD. “Daisy Chaining” light fixtures installed for lay-in ceiling areas is not allowed. Each light fixture shall have its own fixture whip from junction box. The only exception being light fixtures installed end to end using chase nipples between them, or light fixtures recessed in non-accessible ceilings.
- EE. In above ceiling applications, do not install raceways, junction boxes, gutters, disconnects, etc. within 36 inches directly in front of HVAC control boxes or other equipment requiring access from a point starting from the top of control box / equipment down to ceiling.
- FF. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.
- GG. Install minimum size 2 inch nipple, at least one, between multi-sectional panels for branch circuit independent of feeder conductors.

3.2 CONDUITS

- A. Conduit above grade indoors:
 - 1. Concealed Conduits: EMT with set screw fittings
 - 2. Exposed conduits:
 - a. Below nine feet AFF where not directly attached and against building walls, ceiling, or structure: Rigid metal conduit or x-wall RTRC.
 - b. Where subject to physical damage: Rigid metal conduit or x-wall RTRC.
 - c. Wet locations: PVC coated galvanized rigid steel or aluminum conduit
 - d. Damp Locations: Aluminum rigid conduit or x-wall RTRC.
 - e. Exposed conduits in mechanical rooms or electrical rooms shall be rigid galvanized steel or x-wall RTRC when installed below 18-inches above finished floor.
- B. Conduit installed above grade outdoors:
 - 1. Galvanized rigid steel or x-wall RTRC for conduits up utility poles and where subject to physical damage or where located less than four feet above finished floor.
 - 2. Aluminum or x-wall RTRC where not subject to physical damage and where located four feet above finished floor.
- C. Conduit where indicated underground:
 - 1. PVC Coated Galvanized rigid steel or RTRC conduit elbows and PVC, RTRC, or

PVC coated galvanized steel straight run conduits.

- a. PVC conduit and fittings shall be used only for straight horizontal runs and for vertical risers at site lighting pole bases. Bending straight sections of PVC conduit to less than 25-foot radius or the use of PVC factory bends is not allowed.
 - b. Change in direction of conduit runs, either vertical or horizontal, shall be with RTRC or PVC coated galvanized steel elbows or long sweep bends of straight PVC conduit sections. Long sweep bends of straight PVC 20-foot sections shall have a minimum radius of curvature of 25 feet and a maximum arc of 22.5degrees. Multiple long sweep bends of straight PVC sections shall be separated by a minimum of 20-feet of straight, linear, PVC sections.
 - c. Provide RTRC or PVC coated rigid galvanized steel conduit elbows and fittings with urethane interior coating at all changes in direction with radius of less than 25-feet and at all vertical runs to 18 inches above finished floor elevation. For interior slab penetrations, provide continuous RTRC or PVC coated rigid galvanized steel conduit and fittings with urethane interior coating from change in direction to 18 inches above finished floor elevation, except where stubbed-up under and inside equipment or switchgear where conduit shall be terminated at minimum two inches above concrete housekeeping pad.
 - d. Elbows for underground electrical service entrance, feeders, transformer primary / secondary, telecommunication, and low voltage conduits shall be RTRC or PVC coated rigid galvanized steel with long radius as follows:
 - 1) Up to 1-inch conduit, minimum 12-inch radius.
 - 2) 1.5-inch conduit, minimum 18-inch radius.
 - 3) 2-inch conduit, minimum 24-inch radius.
 - 4) 2.5-inch conduit, minimum 30-inch radius.
 - 5) 3-inch conduit, minimum 36-inch radius.
 - 6) 3.5 to 6-inch conduit, minimum 48-inch radius.
 - e. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.
 - f. Conduits shall not be routed horizontally in building slab, grade beams or pavement.
1. Conduits located outside building, provide magnetic locator tape at top of first compacted layer of backfill or concrete.
 2. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel with diameter ¼-inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
 3. Contractor shall stake out routing and location of underground conduits using actual field measurements. He shall obtain approval of the Owner and Architect before beginning trenching, horizontal drilling, and excavation.
 4. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways. Verify existing public utilities with Call811.

- D. Conduit shown in concrete walls, floor or roof slab:
 - 1. PVC Coated Galvanized Rigid steel.
- E. Light fixture whips:
 - 1. Accessible ceilings and open structure: ½-inch flexible steel conduit or steel MC cable, length not to exceed 6-feet.
 - 2. Non-accessible ceilings: ½-inch flexible steel conduit. Length as required to make a tap at an accessible j-box. Recessed light fixtures in non-accessible ceilings may be daisy chained using the light fixture's integral, UL listed j-box or internal wire way that is accessible through fixture from below the ceiling.
 - 3. Dedicated insulated ground wire.
 - 4. Light fixture whips shall not rest on ceiling grid or tile.
 - 5. Light fixture whips shall not be supported from the ceiling suspension system. Support from the structure with #13 AWG galvanized iron wire pendants and Caddy clips. Do not support conduit from structural bridging. Flexible conduit and steel MC cable shall be kept a minimum of 2 inches clear of roof deck.

3.3 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

- A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, all floors other than grade level, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
 - a. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
 - b. Sleeves shall extend 3-inches above the finished floor.
- B. Sleeves in concrete or masonry walls shall be RTRC or Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.
- C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.
- D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to install a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.
- E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with ¼-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.
- F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.

- G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.4 ALUMINUM ALLOY CONDUCTORS

- A. Where aluminum alloy conductors are specified, approved and substituted for copper conductors, provide the required conduit size based on conduit fill using NEC or recognized cable manufacturer's conduit fill tables for aluminum alloy compact conductors.

3.5 IDENTIFICATION

- A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V or 277/480V) or signal / telecommunication conduit (Fire Alarm, BAS, BMCS, Security, CCTV, Access Control, Intrusion Detection, Telecom, etc.). Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

SECTION 260535 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical connections as required and scheduled, and as specified.

1.2 RELATED WORK

- A. Refer to other Divisions for specific individual equipment electrical requirements.

1.3 QUALITY ASSURANCE

- A. UL Label: Products shall be UL listed to the extent possible.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide a complete assembly including, but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories needed to complete splices and terminations.
- B. Raceways: Refer to related sections.
- C. Conductors and Connectors: Refer to related section. Conductors at equipment terminations shall be copper.
- D. Terminals: Provide electrical terminals as indicated by the terminal manufacturer for the application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.
- B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.
- C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.

- D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.
- E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.
- F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable conduit, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. For motors 10 HP and larger, at the motor connection do not use wire nuts. Provide copper alloy split bolt connectors or compression lugs and bolts. Insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape, or Tyco Gelcap Motor Connection Kit.
- G. Conduit connections to equipment including, but not limited to, Variable Frequency Drives, Manual and Automatic Transfer Switches, Surge Suppression Devices, motor controllers, electrical disconnects, / processing equipment, electronics, control panels and Owner furnished equipment:
 - 1. Make conduit penetrations only at the bottom flat surface of the equipment and only where permitted by the equipment manufacturer to avoid un-intentional water entry. Coordinate installation of electrical connections for equipment with equipment installation work. Where equipment manufacture does not permit a bottom conduit entry, verify with Owner/Engineer and locate the conduit entry at the side surface as close as possible to the bottom of the enclosure.
 - 2. Where conduit originates from an elevation above the conduit entry, provide a “T” conduit below the enclosure’s bottom elevation. Provide conduit from the conduit up to the enclosure bottom horizontal surface for electrical connection.
- H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.
- I. Equipment and Furnishings: Refer to other Divisions. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.

END OF SECTION

SECTION 260536 - SURFACE NON-METALLIC RACEWAY

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish and install a complete system of electrical surface nonmetallic raceways.
- B. This specification covers a surface nonmetallic raceway system used for branch circuit wiring and/or data network, voice, video, and other low-voltage cabling. The nonmetallic raceway system shall consist of raceway, appropriate fittings, and accessories to complete installation.

1.2 CLASSIFICATION AND USE

- A. Surface nonmetallic raceway shall be utilized in dry interior locations only as covered in Article 352 part B of the National Electrical Code, as adopted by the National Fire Protection Association and as approved by the American National Standards institute. The raceway system shall be listed by Underwriter's Laboratories UL-5A.

1.3 SUBMITTALS

- A. Shop Drawings: Submit drawings for review showing the complete layout of all products that make up the complete system for each installation prior to installations with device type (power and data), locations, and circuits identified.
- B. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply", "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
- C. As-Built Drawings: If variations from the approved shop drawings occur during the installation of the system, final, as-built drawings shall be submitted for each item that has been altered.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The surface nonmetallic raceway system specified herein for branch circuit wiring and/or data network, voice, video, and other low-voltage cabling shall be Wiremold or equivalent.

2.2 MATERIALS

- A. The raceway and all system components shall be UL Listed and exhibit nonflammable self-extinguishing characteristics, tested to comparable specifications of UL94V-0. The raceway base, cover, and divider shall be available in 8' and 10' lengths. Raceway color shall be white.
- B. Dual Channel Raceway:

1. The raceway shall be a two-piece design with a base and snap-on cover. The raceway shall maintain complete separation of the power and data channels. Total width shall be 5.32” by 2.68” deep with an approximate wall thickness of .125”.
 - a. The base shall have a 70mm opening, its own 70mm cover and features for mounting device brackets, hanging boxes, wire retainers and snap on faceplates. Divider walls, which snap onto the base to form additional wiring channels, but be available the base shall be manufactured of rigid PVC compound.
 - b. The cover (T70C) shall have flanges for snapping onto the base. The cover shall be manufactured of a rigid PVC compound. The base and cover shall be off-white electrical ivory.
 - c. The divider wall (TGDW) shall have flanges that snap onto the TG-70 base. The divider shall be manufactured of a rigid PVC compound. The divider shall have a smooth texture and be light gray in color.
 2. Fittings: A full complement of fittings (TG series) shall be available including but not limited to flat elbows, internal and external elbows with adjustable angles, tee with insert to separate power and data cabling, cover couplers, base couplers, and end caps. A snap-on transition fitting shall be available to adapt to Panduit T-45, LDP10, LDP5 and LDP3 series raceways. The fittings shall provide a means for connecting to the raceway base and shall be capable of maintaining a 40mm minimum cable bend radius. The fittings shall be manufactured from a rigid PVC (or ABS/PC) compound. They shall overlap the cover and base to hide uneven cuts. All fittings shall be supplied with a base where applicable to eliminate mitering. The fitting color shall match the base and cover color.
 3. Accessories: Device brackets and hanging boxes shall be available for mounting standard devices in-line within the raceway. Faceplates shall be a Pan-Way Snap-On faceplate to match and fit flush with the device bracket. Faceplate color shall match the raceway base and cover.
- C. Single Channel Raceway:
1. The raceway shall be a one-piece solid raceway. Total width shall be 1.01” by 0.55” deep.
 2. Fittings: A full complement of fittings (LDS series) shall be available including but not limited to flat elbows, internal and external elbows, tee, cover couplers, base couplers, and end caps. The fittings shall provide a means for connecting to the raceway base and shall be capable of maintaining a 40mm minimum cable bend radius. The fittings shall be manufactured from a rigid PVC (or ABS/PC) compound. They shall overlap the cover and base to hide uneven cuts. All fittings shall be supplied with a base where applicable to eliminate mitering. The fitting color shall match the base and cover color.
 3. Accessories: Device brackets and hanging boxes shall be available for mounting standard devices in-line within the raceway. Faceplates shall be a Pan-Way Snap-On faceplate to match and fit flush with the device bracket. Faceplate color shall match the raceway base and cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide surface non-metallic raceway only where indicated on the drawings, and only at renovation construction areas where routing conduits or MC cable concealed in existing masonry or concrete block walls is impossible or impractical. Otherwise, raceway shall be provided as specified in Section 26 05 33 Conduit Systems. Prior to construction Contractor shall identify and coordinate with Owner/Architect all locations requiring surface raceway and identify possible alternatives to surface raceway.
- B. Provide dual channel raceway where branch circuit devices are indicated with or adjacent to other non-branch circuit devices. Provide single channel raceway where only branch circuit or only non-branch circuit devices are indicated or required.
- C. Prior to and during installation, refer to system layout drawing containing all elements of the system.
- D. Work shall include furnishing all raceway and appropriate fittings and device plates to install a nonmetallic surface raceway system as indicated in the electrical drawings and in the specification. Installer shall comply with detailed manufacturer's instruction sheets that accompany system components as well as system instruction sheets.
- E. Install surface raceways and fittings in accordance with local codes and applicable sections of the NECA "Standard of Installation".
 - 1. Fasten surface raceway supports to building structure and surfaces.
 - 2. Arrange supports to prevent misalignment during wiring installation.
 - 3. Maintain 12-inch clearance between surface raceway and surfaces with temperatures exceeding 104 degrees F.
 - 4. Cut raceway square as recommended by manufacturer.
 - 5. Ground and bond surface raceway as required.
 - 6. Securely fasten surface raceway supports, boxes, to ceiling, walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors for heavy strain. Use only zinc plated or galvanized bolts, screws.
 - 7. Route all surface raceways perpendicular or parallel to building lines.
 - 8. Completely install each surface raceway run prior to pulling conductors. All surface raceways are to be accessible after completion of construction.
- F. All surface raceways must be kept dry and free of water or debris.
- G. Install all surface raceways in the most direct, neat and workmanlike manner to conserve building space and not obstruct equipment service space or interfere with use of space.
- H. Run surface raceway to avoid proximity to heat producing equipment, piping, and flues, keeping a minimum of 8-inches clear.
- I. Install surface raceway as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Fasten the entire surface raceway into position.

END OF SECTION

SECTION 260537 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Label: Electrical boxes and fittings shall be UL listed.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
 - 1. Type of Various Locations:
 - a. Wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613, 4-gang steel box with white trim plate.
 - b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes. Raco #260H large capacity box with ½ through 2-inch knockouts.
 - c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
 - d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
 - e. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be coordinated for each installation.
 - f. Surface: Type FS or FD box with surface cover.
 - g. Corrosive locations or natatorium areas: 316 stainless steel construction suitable for the installation.
 - h. Special: Where above types are not suitable, boxes as required, taking into account space available, appearance, and Code requirements
 - 2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.

- B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate with spring-hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.
- C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.
- D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
 - 1. Type for Various Locations:
 - a. Minimum Size: 4-inch square, 2-1/8-inches deep.
 - b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
 - c. Exterior or Wet Areas: 304 stainless steel NEMA 4X construction with gaskets and corrosion-resistant fasteners
- E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.
- F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.
- G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

PART 3 - EXECUTION

3.1 INSTALLATION OF BOXES AND FITTINGS

- A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.
- B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.
- C. Provide minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes for technology, data, voice, video, and multi-media outlet boxes at locations other than wall mounted interactive boards, video or visual displays. Provide single gang only, 3-inch deep outlet boxes mounted long axis vertically for security, access control, and video surveillance, coordinate with security equipment installation. Provide minimum 4-inch square (2-gang) 2-1/8-inch deep boxes for all other applications. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to

installation. Box extenders or plaster rings shall not be used to increase size. Provide increased box size as required.

- D. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light fixtures, mechanical equipment or other devices shall not be required to access boxes. Outlet boxes above ceiling for low voltage terminations shall face towards the floor.
- E. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes can be used.
- F. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.
- G. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.
- H. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.
- I. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.
- J. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- K. Provide knockout closures to cap unused knockout holes in boxes.
- L. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.
- M. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.
- N. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.

- O. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.
- P. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.
- Q. Exterior boxes installed within 50-feet of cooling towers or water treatment areas shall be of 304 stainless steel, weatherproof NEMA 4X construction.
- R. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes located above accessible ceilings or non-finished areas to correspond to the following colors:
 - 1. Orange: - 480/277 VAC systems
 - 2. Light Blue: - 240 VAC three phase delta systems.
 - 3. Red – All Emergency circuits, regardless of load, and fire alarm system.
 - 4. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
 - 5. Yellow – Building Management and Control System - BMCS
 - 6. White - Security and Surveillance equipment circuits
- S. Identification: All junction and pull boxes located above accessible ceilings or non-finished areas, regardless of size, shall have exteriors and covers painted per following:
 - 1. Yellow – 277/408V Systems
 - 2. Light Blue – All voltages serving mechanical miscellaneous equipment power (do not paint a dark blue color)
 - 3. Red – All voltages serving emergency power / circuits and fire alarm system
 - 4. Light Green – 120/208/240V systems (do not paint a dark green color)
 - 5. Orange – solar photovoltaic systems
- T. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example “MSB to Panel HA”). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example “LA2” referring to Panel LA sec. 2 is to be listed as “LA”). Label covers for special applications explaining contents (example “Emerg. Gen. Annunciator controls”, “IDF ground”). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers. Boxes that are not used shall be labeled as not used and include panel ID. Example “Not Used Panel LA”. Unused raceways not in sight of panel shall be terminated in a box and labeled not used and include panel identification.
- U. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- V. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.
- W. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- X. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.

- Y. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.
- Z. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- AA. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.
- BB. Use adjustable steel channel fasteners for hung ceiling outlet box.
- CC. Do not fasten boxes to ceiling support wires.
- DD. Support systems are to hang vertically straight down. All-thread supports, when used, are not to be installed at an angle or bent.
- EE. Use gang box where more than one device is mounted together. Do not use sectional box.
- FF. Use gang box with plaster ring for single device outlets.
- GG. Support outlets flush with suspended ceilings to the building structure.
- HH. Mount boxes to the building structure with supporting facilities independent of the conduits or raceways.
- II. Where multiple feeders are in one pull box, conductors shall be wrapped with 3M No. 7700 Arc and fireproof tape.
 - 1. Provide plaster rings of suitable depth on all outlet boxes. Face of plaster ring shall be within 1/8 inch from finished surface.
- JJ. Equip boxes supporting fixtures designed to accept fixture studs with 3/8-inch stud (galvanized malleable iron) inserted through back of box and secured by locknut. Boxes not equipped with outlets shall have level metal covers with rust-resisting screws.
- KK. Do not mount junction boxes above inaccessible ceilings or in inaccessible spaces. Do not mount junction boxes above ceilings accessible only by removing light fixture, mechanical equipment or other devices. At inaccessible spaces use junction box furnished with light fixture or light fixture wiring compartment UL listed for through wiring.
- LL. No more than 12 conduits containing branch circuits may be installed in any junction or pull box.
- MM. All junction boxes shall be protected from building finish painters' over spray and from fire proofing overspray. Remove protective coverings when painting and fire proofing are complete.
- NN. Bond equipment grounding conductor to all junction and pull boxes.

- OO. Do not mount boxes or conduit bodies on walls directly above electrical panels or switchgear located next to walls.
- PP. Do not mount boxes or conduit bodies within 18 inches of outside edges of roof access openings.
- QQ. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box. Provide proper size box.

3.2 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

END OF SECTION

SECTION 260539 - MANUFACTURED WIRING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. At the Contractor's option, manufactured wiring systems may be utilized for branch circuit wiring downstream of the home run outlet or junction box in concealed, indoor areas as defined in NEC 330, subject to acceptance by the State and Local Codes.
- B. Provide branch circuit wiring system consisting of manufactured wiring components. The manufactured wiring system to be used for applicable lighting and convenience power branch circuits in accessible areas, concealed from public view, home run junction box and individual light fixtures and 120 volt, 15 and 20 amp receptacle outlets.
- C. The system shall be supplied in accordance with Underwriters Laboratory Standard 183 for Manufactured Wiring Systems, 2002 revision level. All system components, and installation, must meet requirements of Article 604 of the National Electrical Code, applicable local codes plus the manufacturer's installation instructions.
- D. Modular wiring system for general branch circuit shall be capable of handling a minimum of 5 conductors; with 1 conductor a full size ground wire.
- E. Modular wiring for isolated ground branch circuit shall be 6 wires.

1.2 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum of ten years of experience.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All modular wiring mating components to be enclosed in galvanized die formed steel and shall be keyed for voltage and function. Latching between components shall be positive and eliminate any possibility of a partial connection.
- B. All modular wiring components constructed with cable shall use listed MC Cable (with ground), Flexible Metal conduit or liquid-tight Flexible conduit. Cable or conduit type is to be determined by application and use.
- C. All system conductors shall be stranded with 90-degree THHN insulation, nominal 600 volts. The minimum conductor size for components rated at 20-ampere to be #12 AWG copper. #10 AWG copper conductors to be provided where voltage drop or harmonics dictates the need for #10.
- D. Electrical contacts to be manufactured from brass alloy and plated to prevent oxidation.
- E. Contact design must be self-cleaning.

- F. Contact housing to be manufactured using a low smoke compound approved for environmental air spaces other than ducts or plenums. The line-side power outlet shall have a dead front design to prevent inadvertent contact with live components.
- G. The manufacturer shall supply a dust cover, listed for the purpose, to cap unused outlets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Modular wiring starters to be installed in listed electrical enclosures. Field connections to the building distribution wiring shall be completed per acceptable NEC practice.
- B. All cables assemblies to be properly supported according to the NEC. Maintain clearances as specified in Section 26 05 33.
- C. All unused outlets must be capped with a dust cover provided by the manufacturer.
- D. Install manufactured wiring systems downstream of hone run outlet or junction box. Install manufactured wiring systems in accordance with local codes and applicable sections of the NECA “Standard of Installation” in concealed locations only. Manufactured wiring systems shall not be used in any kitchen or food preparation areas, gymnasiums, natatoriums, or vocational shop areas.
 - 1. Fasten manufactured wiring system supports to building structure and surfaces.
 - 2. Do not support manufactured wiring systems with wire or perforated pipe straps. Remove wire used for temporary supports.
 - 3. Do not attach manufactured wiring systems to ceiling support wires.
 - 4. Arrange manufactured wiring systems to maintain head room and present neat appearance.
 - 5. Maintain 13-inch clearance between manufactured wiring systems and surfaces with temperatures exceeding 104 degrees F.
 - 6. Do not cut or alter manufactured wiring system components or cable.
 - 7. Ground and bond manufactured wiring systems as required.
 - 8. Identify manufactured wiring systems as required.
 - 9. Route all manufactured wiring systems perpendicular or parallel to building lines.
- E. Group related manufactured wiring systems; support using conduit rack or cable tray. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- F. Securely fasten manufactured wiring systems, supports and boxes, to ceiling, walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.
- G. Provide separate manufactured wiring systems for each of the following when specified, indicated or required:
 - 1. 120/208 volt circuits
 - 2. 277/480 volt circuits

- H. Do not install manufactured wiring systems in or below concrete slabs, outdoors, at wet or damp locations, or in exposed areas.
- I. In suspended ceilings, support from the structure, not the ceiling system construction.
 - 1. Do not support from structural bridging.
 - 2. Do not support from metal roof deck. Maintain minimum 2-inch clearance from roof deck.
- J. Hold horizontal and vertical manufactured wiring systems as close as possible to walls, ceilings and other elements of the building construction.
- K. Install all manufactured wiring systems perpendicular or parallel to building lines in the most direct, neat and workmanlike manner.
 - 1. Install manufactured wiring systems to conserve building space and not obstruct equipment service space or interfere with use of space. Manufactured wiring systems shall not be routed on floors, paved areas or grade.
- L. Run manufactured wiring systems to avoid proximity to heat producing equipment, piping, and flues, keeping a minimum of 8-inches clear.
- M. Conceal manufactured wiring systems in all areas. Manufactured wiring systems can be exposed in mechanical and electrical rooms for lighting circuits only.
- N. Support manufactured wiring systems on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Where rod pendants are not used, channel supports are to be secured to structure at each end. Manufactured wiring systems supports are to be secured to structure using washers, lock washers; nuts and bolts or rod pendants (use of toggle bolt “wings”) are not acceptable. Support single manufactured wiring system runs using a properly sized galvanized conduit hanger with galvanized closure bolt and nut and threaded rod. Raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Do not support manufactured wiring systems from structural bridging or fire rated ceiling system. Do not support more than one manufactured wiring system from a single all-thread rod support. Channel supports shall have cut ends filed smooth.
- O. Manufactured wiring systems for lighting fixture connection shall be supported from the structure with #13 AWG galvanized iron wire pendants and "Caddy clips". Manufactured wiring systems for lighting fixture connection can be supported from the ceiling suspension system using "Caddy clips". Do not support manufactured wiring systems from structural bridging.

END OF SECTION

SECTION 260550 – FIRESTOPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson
- B. 3M (Minnesota Mining Manufacturing)
- C. Hilti
- D. Specified Technologies, Inc.

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install items for identification of electrical products installed under Division 26.

1.2 SUBMITTALS

- A. Submit product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. W.H. Brady Co.
- B. Carlton Industries, Inc.
- C. Seton Nameplate Co.

2.2 MATERIALS

- A. Nameplates: Provide engraved three-layer laminated plastic nameplates with white letters on a black background.
- B. Wire and Cable Markers: Provide vinyl markers with split sleeve or tubing type, except n manholes provide stainless steel with plastic ties.
- C. Underground Warning Tape
 - 1. Manufactured polyethylene material and unaffected by acids and alkalis.
 - 2. 3.5 mils thick and 6 inches wide.
 - 3. Tensile strength of 1,750 psi lengthwise.
 - 4. Printing on tape shall include an identification note BURIED ELECTRIC LINE, and a caution note CAUTION. Repeat identification and caution notes over full length of tape. Provide with black letters on a red background conforming to APWA recommendations.
- D. Panelboard Directories: Provide a typed circuit directory for each panelboard. Mount circuit directory in a permanent, clear lexan card holder locate don inside of door on panelboard.
- E. Conduit Markers: Flexible vinyl film with pressure sensitive adhesive backing and printed markings.
 - 1. Electrical conduit markers shall include three identifying titles on an orange background except as noted.
 - a. Typical
 - 1) Type Example – AC 60 Hertz
 - 2) Load Example – Lighting and Power

- 3) Voltage Example – 480 VAC / 3 Phase
- b. As Noted
 - 1) If more than one type of power is available in a conduit, then it shall be marked with the title “Electrical” on orange background.
 - 2) Limit switch controls, air conditioning controls and diffuser controls shall be marked with the title “Control” on an orange background.
2. Conduit that contains protective or communications systems shall have the exact content and title on blue background and installed and located as specified for conduit.

F. Conduit Markers and Letter Size

1. Dimensions

Outside Diameter of Conduit in Inches	Width of Color Band in Inches	Height of Letter & Numerals in Inches
½ to 1-1/4	8	½
1-1/2 to 2	8	¾
2-1/4 to 3-1/4	10	1
3-1/2 & Larger	12	1-1/4

PART 3 - EXECUTION

3.1 IDENTIFICATION OF EQUIPMENT

A. Identification of Equipment:

1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
2. A black-white-black (red-white-red for emergency circuits) 3 layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, wireway, busduct plug, terminal cabinet, surge protection device, capacitor, individual motor controller, contactor and communications (voice, data, video) cabinet or rack with stainless steel screws.
 - a. Identifying nameplates shall have 1/2-inch high, engraved letters. For equipment designation and ¼-inch letters indicating source circuit designation, (i.e.: “PANEL HA –served from MDP-6”).
 - b. Each switchboard, distribution panel, and motor control center branch circuit device shall have a nameplate showing the load served in ¼-inch high, engraved letters.
 - c. Enclosed switches, starters, circuit breakers and contactors: Provide neatly typed label inside each motor starter and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating. Provide Phenolic nameplate on cover exterior to indicate motor or load served, panel(s) and circuit(s) serving load(s), description and location of control controlling contactor (i.e.: contactor controlled by switch in Room A107.), and panel

and circuit feeding line side of control transformer. Example of label for lighting / receptacle contactor: Lighting Contactor

Panel HA 2,4,6

Control circuit – Panel HA 2,4

Location – West parking Lot Pole Lights

Switched - BMCS

3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front, or in a clear plastic schedule holder. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as “corridors”. Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect’s final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.
 4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, clearly indicating the panel and branch circuit numbers available at that junction box. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
 5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner’s motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.
- B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.

- E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried electrical lines; telephone lines and data lines. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.

3.2 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Embossed tape will not be accepted.
- E. Provide underground tape at all electrical installations.

3.3 CONDUIT MARKERS

- A. Location of Identifying Markers: At each end of conduit run and at intermediate points 50' on center maximum.

END OF SECTION

SECTION 260923 - LIGHTING OCCUPANCY SENSORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide occupancy sensing control devices so that lighting is turned off automatically in individual rooms or sections of rooms after a reasonable time delay when the last person leaves the room or area.
- B. Occupancy sensing controls shall accommodate for irregular use of rooms or areas, all individual work habits, and all occupancy habits or conditions of space utilization. Occupancy sensors must provide full volumetric coverage.

1.2 SCOPE

- A. Contractor shall furnish and install a complete and operable occupancy sensing lighting control devices, as described in the specifications herein.
- B. Work included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other specification sections and drawings for related work required to be included as work under Division 26.
 - 2. General provisions and requirements for electrical work.
 - 3. Refer to Section 26 27 73 Wiring Devices for wall switch cover plates.

1.3 QUALITY ASSURANCE

- A. Product manufacturer shall have a minimum of (5) years experience in the manufacturing of occupancy sensors.
- B. All components shall be UL listed, meet all state and local applicable code requirements.
- C. All components shall offer a five (5) year manufacturer's warranty.

1.4 SUBMITTALS

- A. Submit applicable manufacturer's specifications sheets, installation instruction, wiring diagrams and performance data for all components required.
- B. Submit floor plans indicating ceiling heights and coverage patterns of all occupancy sensors to indicate complete coverage of small motion. Occupancy sensor layout shall be prepared by the manufacturer. Minimum size floor plans 11x17 inch; minimum scale one inch equals 16 feet.
- C. Provide a complete written item-by-item, line-by-line specification review stating compliance or deviation in full description. Any deviations to this specification must be

clearly stated in writing. It is the contractor's responsibility to provide submittals that meet or exceed the specifications herein prior to commencement of work.

- D. Submit a sample of each style and color of occupancy sensor and switch with related cover plate. Attach plate to wiring device and label backside of plate with job description with permanent black marker.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Greengate
- B. Watt Stopper
- C. My-Tech
- D. Hubbell
- E. Leviton
- F. Sensor Switch
- G. Schneider Electric
- H. Cooper

2.2 OCCUPANCY SENSORS

- A. Part numbers based on Greengate. Device color shall be white.
- B. Wall switch sensors:
 - 1. Line Voltage 01-400, 01-DL 400
- C. Dual Technology Sensors 01-300, 01-310
- D. High Bay Sensor 01-320
- E. Extreme Temperature Sensor 01-340

2.3 FEATURES AND PERFORMANCE PARAMETERS

- A. Line voltage wall switch sensor shall include zero crossing switching circuit. Sensor shall operate at 30-34 kHz.
- B. Line voltage wall switch sensors shall be ultrasonic and/or passive infrared and provide no-gap minor motion coverage of an area up to 300 square feet.
- C. Line voltage wall switch sensors shall operate on either 120V or 277V and control loads up to 800 watts at 120V and 1200 watts at 277V.

- D. Line voltage wall switch sensors shall be compatible with magnetic and electronic ballasts, shall be equipped with high capacity relay contacts with ratings that include tungsten loads.
- E. Wall switch sensors shall mount flush into a designer-style wall plate.
- F. Ultrasonic wall switch sensors shall screen out false activation from corridor traffic by reducing sensitivity to motion after the time delay and "grace period" have elapsed. Infrared wall switch sensors shall screen out false activation from corridor traffic with blinders located on either side of the lens by which means the range of the horizontal field of view can be adjusted.
- G. Dual Technology sensors shall provide no-gap minor motion coverage throughout the entire controlled area.
- H. Dual Technology, and High Bay sensors shall be available in more than one frequency to enable individual control of adjacent spaces without gaps in coverage.
- I. Dual Technology, High Bay and Extreme Temperature sensors shall operate on 15 VDC.
- J. All sensors shall operate on 24 VAC as supplied by a class 2 transformer and provide an isolated (dry) maintained Form C contact closure to signal occupancy/no occupancy for Building Management and Control (BMCS / BAS) Systems.
- K. All sensors shall have a manual override switch to allow the load to be turned on without the use of tools or pins in the event of sensor malfunction.
- L. Wall Switch, Dual Technology, and High Bay Sensors shall have easily accessible, adjustable controls for time delay and sensitivity. Controls shall be recessed to limit tampering.
- M. Ultrasonic Wall Switch, Dual Technology, and High Bay Sensor housings shall comply with UL 94V0 and shall be equipped with a protective grill to shield detectors from damage.
- N. All sensors shall be provided with an indicator light to verify that motion is being detected and that the unit is in operation.
- O. Ultrasonic wall switch sensors shall contain timing circuitry to provide adjustable "time to lights off" delay of 15 seconds to 15 minutes.
- P. Infrared wall switch sensors shall contain timing circuitry to provide adjustable "time to lights off" delay of 30 seconds to 30 minutes.
- Q. Dual Technology, High Bay and Extreme Temperature sensors shall contain timing circuitry to provide adjustable "time to lights off" delay.
- R. All ultrasonic sensors shall be crystal controlled to within +/- 0.005% tolerance to assure constant and stable performance.

- S. The High Bay Sensor and Extreme Temperature Sensor shall be HID Bi-Level dimming compatible with HID dimming ballasts/systems.
- T. Dual Technology, High Bay and Extreme Temperature sensors shall include an Internal pull-up switch or jumper for choosing an open collector with or without pull-up when connecting to a BAS system.
- U. Dual Technology, High Bay and Extreme Temperature sensors shall include a lighting sweep function that shall ensure that lights remain off immediately after power on sweeps.
- V. All ceiling sensors shall be mounted through a single hole.
- W. High bay and Extreme Temperature sensors shall feature versatile mounting options to surface, 2S or 4S junction box.
- X. Dual Technology and High Bay sensors shall include a Self-Adjusting Time Delay that shall reset the time delay automatically to 10 minutes after an hour of lights staying off, if left at the minimum setting.
- Y. Extreme temperature sensors shall include a Self-Adjusting Time Delay that shall reset the time delay automatically to 6 minutes after an hour of lights staying off, if left at the minimum setting.
- Z. The Extreme Temperature Sensor shall include built in temperature compensation circuitry and algorithm that shall minimize false activation caused by natural factors such as wind, temperature change, etc.
- AA. The High Bay Sensor shall be available with an independently adjustable two-way coverage pattern.
- BB. The High Bay Sensor shall be able to detect the major types of motion (i.e., driving a forklift or walking into an aisle) of people in controlled areas of a warehouse or other High Bay area.
- CC. Dual Technology, and High Bay sensors shall utilize Airflow Tolerant Technology™ to resist false activation in high airflow environments.
- DD. Dual Technology, High Bay and Extreme Temperature sensors shall self-adjust sensitivity to optimize performance.
- EE. All sensors shall utilize the NEMA WD 7 Guide and robotic method to verify coverage patterns.
- FF. All sensors and Switchpacks shall be manufactured by the same company and shall be aesthetically compatible, i.e., from the same product line or generation of products.

2.4 SWITCHPACKS

- A. Part numbers based on Greengate:
BAS 13-041*

Heavy Duty 13-051*

*For use with Greengate Designer, Standard and Airflow Tolerant series, and Dual Technology, High Bay and Extreme Temperature sensors and 01-220 Wall Switches only.

- B. For ease of mounting, installation and future service, Switchpacks shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and shall be an integrated, self contained unit consisting internally of a load switching relay and transformer to provide low voltage power of 15 VDC. Switchpacks shall power up to five (5) sensors.
- C. Relay contacts shall be isolated and have ratings of:
 - 15 Amps: 120 VAC Tungsten
 - 20 Amps: 120 VAC Ballast
 - 20 Amps: 277 VAC Ballast

 - 1HP: 120 VAC
 - 2HP: 250 VAC
- D. Enclosures for Switchpacks shall be pressed steel, NEMA I Construction with mounting plates and barriers to provide separation between line and low voltage wiring or standard 4" deep junction box with Switchpack mounting through a 1/2" knockout.
- E. The Heavy Duty Switchpack shall have a heavy duty Form A relay and zero crossing circuitry that forces the relay contacts to engage and disengage at the zero crossing point of the AC voltage source, minimizing the magnitude of the inrush current and increasing the life of the Switchpack.

2.5 LOW VOLTAGE CONTROL WIRING

- A. Control wiring between sensors and switchpacks shall be Class 2, 18 AWG stranded UL classified, Teflon jacketed cable suitable for use in plenum ceilings. Outer jacket insulation color shall be white.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide the quantity of occupancy sensors required for complete and proper volumetric coverage to completely cover the controlled areas. Contractor shall verify room coverage and ceiling heights with manufacturer and provide the quantity of occupancy sensors as required. Rooms shall have one hundred (100) percent volumetric coverage of small motion detection to completely cover the controlled areas to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only rooms that are to be provided with sensors. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural or architectural components. Provide sensors to provide complete and proper volumetric

coverage. Where ceiling mounted devices are indicated, provide only ceiling mounted devices.

- B. Exact locations of Switchpack boxes shall be based on observing good installation practice and shall be consistent throughout the project. Switchpacks shall be located in accessible ceiling spaces. Attention shall be paid to all aspects of installation to ensure that there is the minimum aesthetic impact of the hardware on the appearance of the affected rooms. All control unit hardware shall be completely contained within a suitable NEMA-type enclosure, with no exposed wire other than low voltage Class 2 wiring.
- C. Control units used for the security or fire systems shall be powered from the emergency power source as indicated on the drawings. Other control units shall be powered from the lighting circuit, which they control.

3.2 INSTALLATION

- A. All occupancy sensors and switchpacks shall be of the same manufacturer throughout unless otherwise noted.
- B. Install occupancy sensors in areas indicated, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- C. Install occupancy sensors and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.
- D. Install occupancy sensors plumb and aligned in the plane of the wall, floor, or ceiling in where they are installed.
- E. Install wall occupancy sensor switches in boxes on the strike side of doors as hung. Install a uniform position so the same direction will open and close the circuit throughout the project. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.
- F. Provide a plate for every switch. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.
- G. Mounting heights of all wall occupancy sensor switches shall comply with current Accessibility Standards and local codes.
- H. Refer to Architectural drawing, elevations, etc. for exact location of wall switches where indicated on the Architectural plans. Coordinate location of all wall switches with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction.
- I. Unless indicated otherwise, circuit switchpacks ahead of local control switches - source – switchpack – local toggle switch(s).
- J. Coordinate with BMCS/BAS Contractor for interface of BMCS/BAS System and wiring connections.

3.3 SENSOR TESTING AND ADJUSTMENT

- A. At the time of installation the contractor shall test and adjust each sensor for proper detection of motion appropriate to room usage. The contractor shall follow the testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model.
- B. Prior to testing and adjusting, verify with Owner/Architect the initial settings for each type of area based on its intended function and use.
- C. Verify with Owner all adjustable functions of each type of occupancy sensor prior to installation. Set all adjustable functions of each type of occupancy sensor as directed by Owner. Initial settings unless directed by Owner / Architect:
 - 1. Time delay = maximum
 - 2. Zero Time Delay = Off
 - 3. Auto-On = On
 - 4. Manual-On = Off
 - 5. Self-Adjust = Off
 - 6. Disable Self-Adjust = On
 - 7. Energy Saver (Dual Level) = On
 - 8. Manual Override = Off
- D. Bi-level occupancy wall switches shall be initially set with the energy saver feature enabled.
- E. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check devices to demonstrate proper operation.
- F. Operate each wall switch with circuit energized and verify proper operation.

END OF SECTION

SECTION 260943 - LIGHTING CONTROLS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Lighting control system and components:
 - 1. Touch panel controls
 - 2. Lighting management panels
 - 3. Lighting management modules
 - 4. Low voltage wall stations
 - 5. Power interfaces
 - 6. Wired sensors
 - 7. Stand-alone room based architecture. Provide hardware capable of system network architecture without network connectivity or network interface hardware.

1.2 SUMMARY

- A. The lighting control system specified in this section shall provide, sensor-based (both occupancy and daylight), and manual lighting control, and time based control when configured as a networked system.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Specific dimmers shall be capable of “dimming lights to off”.
- C. All system devices within a group or controlled area shall be networked together, enabling digital communication between devices.
- D. The system architecture shall be capable of enabling stand-alone groups (areas) of devices. If the system is networked together the groups or areas shall continue to function in a default capacity, even if network connectivity to the greater system is lost.
- E. The system architecture shall facilitate remote operation via a computer connection when the system is networked together.
- F. The system shall not require any centrally hardwired switching equipment.
- G. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.
- H. The term “occupancy sensor” shall be interchangeable with the term “vacancy sensor” as the control hardware shall be the same device, and be capable of either function.

1.3 SUBMITTALS

- A. Specification line-by-line compliance review consisting of a marked-up copy of these specifications with contractor comments. Refer to Submittals specification section for additional instructions.

- B. Product Datasheets (general device descriptions, dimensions, electrical specifications, wiring details, nomenclature)
- C. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
- D. Other Diagrams – as needed for special operation or interaction with other system(s)
- E. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up and commissioning.
- F. Hardware and Software Operation Manuals
- G. Other operational descriptions as needed

1.4 PROJECT CLOSEOUT DOCUMENTATION

- A. Provide a factory published manual
 - 1. Warranty
 - 2. Technical support contact
 - 3. Electronic manual on manufacturer's website for free download
- B. Completed Startup/Commissioning Worksheet with Owner's acceptance and date clearly noted.

1.5 QUALITY ASSURANCE

- A. All steps in sensor manufacturing process shall occur in North America; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- B. All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.6 PROJECT CONDITIONS

- A. Only install equipment after the following site conditions are maintained:
 - 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C)
 - 2. Relative Humidity less than 90% non-condensing
- B. Standard electrical enclosures shall be permanently installed
- C. Equipment shall be protected from dust, debris and moisture

1.7 WARRANTY

- A. Five (5) year manufacturer's warranty parts replacement beginning upon completion of Factory Start-up and Commissioning date as noted on the Owner accepted Startup/Commissioning Worksheet.

1.8 MAINTENANCE & SUSTAINABILITY

- A. Provide new parts, upgrades, and/or replacements available for a minimum of 5 years available to the end user
- B. Provide free telephone technical support
- C. Spare Parts: Provide minimum of 1 unit up to 5% of each hardware device product used, whichever is greater.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Acuity Brands Lighting, Inc. - System: nLight
 - 2. Legrand North America, LLC - System: WattStopper DLM
 - 3. Eaton Corporation, PLC – System: Greengate
 - 4. Douglas Lighting Controls
 - 5. Lutron

2.2 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network capable backbone for remote or time based system operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, UL 924 emergency lighting relays, dimming outputs, manual switch stations, manual dimming stations. Combining one or more of these components into a single device enclosure is be permissible so as to minimize overall device count of system.
- C. System may interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches, refer to Networked LED Luminaire section below.
- D. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- E. Devices within a lighting control zone shall be connected with low voltage cabling in any order.

- F. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- G. When Network architecture is implemented, individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- H. Power for devices within a lighting control zone shall come from either resident devices already present for that zone, controls enabled luminaires, or from the network backbone. Standalone “bus power supplies” are not acceptable.
- I. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications may require remote switching and shall be capable of being networked into the system.
- J. Networked systems shall have one or more primary network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- K. Networked Systems may use a network bridge device to route communication and distribute power to directly connect lighting zones together for purposes of decreasing system wiring requirements.
- L. Network system communications shall be hard wired. When systems devices are capable of WiFi, they shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the network bridge devices and all cabling that connects zones to bridge devices. Use of WiFi shall only be enabled with written permission and documentation from the Owner.
- M. Networked systems shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control schedules and profiles.
- N. Individual lighting zones shall be capable of being segmented into several local channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- O. Devices located in different lighting zones shall be able to communicate occupancy, photocell (non-dimming), and switch information via either the wired or WiFi backbone.
- P. Networked systems shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a space’s sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week, utilization of a space.
- Q. Operating modes shall be utilized only in manners consistent with local energy codes.
 - 1. Auto-On / Auto-Off (via occupancy sensors)
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.

- b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - c. Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
- 2. Manual-On / Auto-Off (also called Semi-Automatic)
 - a. Pushing a switch will turn lights on.
 - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
- 3. Auto On / Predictive Off
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - c. Pressing the switch will turn the lights off and a short “exit timer” begins. After the timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
- 4. Multi-Level Operation (multiple lighting levels per manual button press)
 - a. Operating mode designed specifically for bi-level applications.
 - b. Enables the user to cycle through up to four potential on/off/dim low/dim high lighting states using only a single button.
 - c. Eliminates user confusion as to which of two buttons controls which load
 - d. Three different transition sequences are available in order to comply with energy codes or user preference).
 - e. Mode available as a setting on all devices that have single manual on/off switch.
 - f. Depending on the sequence selected, every button push steps through relay/dimming states according to below table
 - g. In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation.

		State of load after each pushbutton press			
MLO Mode		1st Press	2nd Press	3rd Press	4th Press
2-State (Alternating)	Load A	On	Off	Off	-
	Load B	Off	On	Off	-
2-State (Both On, A First)	Load A	On	On	Off	-
	Load B	Off	On	Off	-
2-State (Both On, B First)	Load A	Off	On	Off	-
	Load B	On	On	Off	-
3-State	Load A	On	Off	On	Off
	Load B	Off	On	On	Off
A and B On ¹	Load A	On	Off	-	-
	Load B	On	Off	-	-
A On Only ¹	Load A	On	Off	-	-
	Load B	Off	Off	-	-
A and B On & Dim High ¹	Load A	High	Off	-	-
	Load B	High	Off	-	-
Dim Low /High	Load A	Low	High	Off	-
Dim Low / High	Load A	High	Low	Off	-

NOTE 1: Modes for use only when Auto-On state of Load A & B is different than first MLO state

5. Manual-On to Auto-On/Auto-Off
 - a. Pushing a switch will turn lights on.
 - b. After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

- A. Occupancy sensors (network capable):
 1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
 2. Only passive infrared (PIR) technology, which detects occupant motion, shall be used to initially turn lights on from an off state, thus preventing false on conditions.
 3. Dual technology sensors shall be used. Only where ultrasonic or microphonic technology might create a false occupied state, not allowing the lights to automatically turn off shall PIR only be used. Acceptable dual technology includes PIR/Microphonics technology (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants or PIR/Ultrasonic technology.
 4. Sensors shall include one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only) for BAS/BMCS control.
 5. Sensors shall be available in multiple lens options which are customized for specific applications.

6. All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate of a potential wiring issue
 7. Every sensor parameter shall be available and configurable remotely from the software (when networked) and locally via the device push-button.
 8. System shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
 9. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection. Embedded sensors shall have an optional photocell
 10. Ceiling, fixture, recessed, & corner mounted sensors shall be available.
 11. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
 12. Sensors shall be the following nLight model numbers, with device options as specified:
- B. Daylight (photocell and/or dimming) sensors:
1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
 2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
 3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
 4. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
 5. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
 6. Luminaire mounted dimming photocells shall be embedded into luminaire such that only the lens shows on luminaire face.
- C. Power (Relay) Packs:
1. Power Packs shall incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system.
 2. Power Packs shall accept 120 or 277 VAC, rated for a minimum 16 Amps for any type of lighting load or motor load rated to 1 HP, provide 0-10 VDC dimming control, be plenum rated, and provide Class 2 power to the system.
 3. Every Power Pack parameter shall be available and configurable remotely from the software (if networked) and locally via the device push-button.
 4. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
 5. When required by local code, Power Pack shall install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring

is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

6. Secondary Packs shall be available that provide up to 5 Amps of switching and can line voltage dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
7. Secondary Packs shall be available that provide up to 5 Amps of switching and can dim line voltage 120/277 VAC magnetic low voltage transformers.
8. Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
9. Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits and control of 0-10 VDC dimming circuit.
10. Secondary Packs shall be available that control louver/damper motors for skylights.
11. Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
12. Power (Secondary) Packs shall be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.

D. Relay & Dimming Panels:

1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.

E. Networked Auxiliary Input / Output (I/O) Devices:

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½” knockout.
2. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current.
3. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.
4. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
5. Specific I/O devices shall sense state of low voltage outdoor photocells.
6. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
7. Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).

F. Low Voltage Wall Switches & Dimmers:

1. All devices shall provide toggle on/off switch control.
2. Devices color shall match building standard line voltage wiring device color.

3. Devices with mechanical push-buttons shall provide tactile with LED user feedback.
4. Devices with mechanical push-buttons shall be made available with custom button labeling
5. Devices with a single “on” button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

G. Graphic Wall Station:

1. Minimum 3.5-inch full color touch screen for selecting up to 16 programmable lighting control preset scenes or acting as up to 16 on/off/dim control switches.
2. Color shall match building standard for line voltage switching.
3. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
4. Device shall enable user supplied .jpg screen saver image to be uploaded.
5. Surface mount to single-gang recessed switch box.
6. Micro-USB style connector for local computer connectivity.

H. Scene Controllers:

1. Two, three, four, or eight buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Color shall match building standard for line voltage switching.
3. Devices shall provide LED user feedback.
4. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
5. When networked, the device shall be capable of selecting a lighting profile be run by the system’s upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
6. Device shall have LEDs indicating current selection.

2.4 START-UP & SUPPORT FEATURES

- A. To facilitate start-up, all devices daisy-chained together shall automatically be grouped together into a functional lighting control zone.
- B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide the quantity of sensors required for complete and proper coverage to completely cover the controlled areas. Contractor shall verify room coverage and ceiling heights with manufacturer and provide the quantity and type of occupancy sensors as required. Rooms shall have one hundred (100) percent coverage of small motion detection to completely cover the controlled areas to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only rooms that are to be provided with sensors. Proper judgment must be exercised in executing the work so as to ensure the best

possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components, architectural components, or Owner installed equipment which may cause obstructions to sensor coverage.

- B. Provide ceiling mounted sensors. Wall mounted sensors shall only be used where ceiling mounted sensors are proven by the manufacturer to be impractical.
- C. For ceilings up to 12-feet AFF, control equipment shall be mounted Above ceiling control equipment shall be wall mounted above an accessible ceiling on 24x24-inch fire resistive 0.75-inch thick plywood back board mounted to the wall above the ceiling, directly above the space/area main entry wall switch station, observing good installation practice and shall be consistent throughout the project. Where the ceiling is over 12-feet, the control equipment shall be located in an adjoining ancillary room/area where the ceiling is 12-feet AFF or lower, typically adjacent to the ancillary room/area above ceiling control equipment location.
- D. Control units used for the security or fire systems shall be powered from the emergency power source as indicated on the drawings. Other control units shall be powered from the lighting circuit, which they control.

3.2 INSTALLATION

- A. When using wire for connections other than Cat 5e with RJ-45 connectors, provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements.
- B. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- C. The installing electrical contractor shall complete, prior to request of factory start up and site commissioning, complete installation of all devices, their respective loads landed and confirmed operations, switches installed, and confirmed operational.
- D. The installing contractor shall, prior to request of factory start up and site commissioning, request an on-site meeting by including the manufacture's local authorized representative, the Owner and the general contractor, to assist in identification of any open ended issues, thereby eliminating potential for delays and system commission interruptions.
- E. Upon confirmation of progress by local factory representative, the installing electrical contractor shall complete the manufacture's start up request form(s), including any field changes from the contract documents.
- F. The installing electrical contractor shall provide a preliminary as-built drawing prior to commissioning to the manufacture's representative. Drawing shall include all wire routing, room by room device ID's and locations of all lighting control devices.
- G. Install sensors in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.

- H. Install sensors and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.
- I. Install sensors plumb and aligned in the plane of the wall, floor, or ceiling in where they are installed.
- J. Install wall occupancy sensor switches in boxes on the strike side of doors as hung. Install a uniform position so the same direction will open and close the circuit throughout the project. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.
- K. Provide a cover plate for every switch. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.
- L. Refer to Architectural drawing, elevations, etc. for exact location of wall switches where indicated on the Architectural plans. Coordinate location of all wall switches with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction. Mounting heights of all switches shall comply with current Accessibility Standards and local codes.
- M. Unless indicated otherwise, circuit relays/switchpacks ahead of local control switches. Source → relay/switchpack → local toggle switch(s).
- N. Coordinate with BMCS/BAS Contractor for interface of BMCS/BAS System and wiring connections.

3.3 SENSOR TESTING AND ADJUSTMENT

- A. At the time of installation the contractor shall test and adjust each sensor for proper detection of motion appropriate to room usage. The contractor shall follow the testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model.
- B. Prior to testing and adjusting, verify with Owner/Architect the initial settings for each type of area based on its intended function and use.
- C. Verify with Owner all adjustable functions of each type of occupancy sensor prior to installation. Set all adjustable functions of each type of occupancy sensor as directed by Owner. Initial settings unless directed by Owner / Architect:
 - 1. Time delay = maximum
 - 2. Zero Time Delay = Off
 - 3. Auto-On = On (Occupancy) Auto = OFF (Vacancy)
 - 4. Manual-On = Off
 - 5. Self-Adjust = Off
 - 6. Disable Self-Adjust = On
 - 7. Energy Saver (Dual Level) = On
 - 8. Manual Override = Off

- D. Bi-level occupancy wall switches shall be initially set with the energy saver feature enabled.
- E. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check devices to demonstrate proper operation.
- F. Operate each wall switch with circuit energized and verify proper operation.

3.4 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. The factory commissioning shall include the following services. Programming of all button stations, configuration and of all occupancy sensors and photocells.
- C. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting set points.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters
- D. The electrical contractor shall provide by digital formatting to the manufacturer, General Contractor, Architect, and the Owner with 21 Owner's business days' written notice of the requested system startup and adjustment date.
- E. The electrical contractor shall provide at least (1) journeyman electrician familiar with the installation of the system dedicated to assisting the factory start-up technician for the entire duration of the commissioning process.
- F. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the Owner's personnel on the adjustment and maintenance of the system.
- G. Re-commissioning – After 90 days from certificate of occupancy, re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

END OF SECTION

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SECTION 261215 - DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Low Voltage (less than 600 Volt) transformer work as shown, scheduled, indicated, and specified.
- B. Types: Transformers required for the project include dry-type transformers.

1.2 QUALITY ASSURANCE

- A. Standards: Transformers shall be designed and tested in accordance with NEMA and ANSI C33.4 and C89.2 standards.
- B. UL Label: Transformers shall be UL labeled.

1.3 STANDARDS

- A. UL-506
- B. ANSI C75.11
- C. NEMA ST-20
- D. DOE 2016 Efficiencies

1.4 SUBMITTALS

- A. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, sound level, tap configurations, insulation system type and rated temperature rise.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. General Electric
- C. Siemens
- D. Eaton
- E. Acme
- F. Hammond

2.2 MATERIALS AND COMPONENTS

- A. Except as otherwise indicated, provide transformer manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended, and as required for a complete installation.

2.3 DRY-TYPE TRANSFORMERS

- A. General: Indoor transformers shall be dry-type, multiple-winding transformers, rated as shown, and shall have manufacturer's standard impedance.
- B. Construction: Transformer core shall be constructed of cold-rolled, oriented, high permeability silicon steel, either formed as a coil or laminated.
- C. Taps: Transformers 15 to 30 kva shall have two 5% taps, one above and one below normal. Transformers 45 kva and larger shall have four 2-1/2% taps, two above and two below normal.
- D. Temperature Rating: Transformers shall use an insulation system that has been temperature classified and approved by UL. Transformers shall have a maximum winding temperature rise of 150°C with an insulation system temperature classification of 220°C.
- E. Load Rating:
1. Transformers shall be capable of operating at 100% of nameplate rating continuously while in an ambient temperature not exceeding 40°C.
 2. Transformers shall be capable of meeting the daily overload requirement of ANSI C57.12.
- F. Vibration Isolation: Each transformer core and coil shall be mounted in the transformer enclosure on rubber vibration isolators.
- G. Sound Rating: The transformer shall have sound levels equal to or lower than those ratings established in NEMA ST-20 and as shown in the following table. Sound ratings shall be measured in accordance with ANSI C89.91.

Transformer Rating (kva) (600 Volt Class)	Maximum Sound Level Decibels: NEMA ST- 20
0 to 9	40
10 to 50	45
51 to 150	50
151 to 300	55
301 to 500	60

- H. Testing:
1. The manufacturer shall have tested each transformer for proper operation before shipment.
 2. The manufacturer shall have performed the following additional tests on units identical to the design type being supplied. Furnish proof of performance of these

tests in the form of test data sheets upon request:

- a. Sound levels.
- b. Temperature rise tests.
- c. Full-load core and winding losses.
- d. Percent regulation with 80 and 100% power factor load.
- e. Percent impedance.
- f. Exciting current.
- g. Insulation resistance.

PART 3 - EXECUTION

3.1 INSTALLATION OF TRANSFORMERS

- A. General: Install transformers where shown, in accordance with the manufacturer's written instructions and industry practices to ensure that the transformers meet the specifications. Comply with requirements of NEMA and NEC standards, and applicable portions of NECA Standard of Installation, for installation of transformers. Transformers shall be floor mounted. Ceiling mounted transformers are not acceptable.
- B. Dry-Type Transformer Mounting: Indoor, floor mount transformer on properly sized Amber/Booth Type RVD rubber-in-shear vibration isolators. Only where specifically indicated on the plans or approved in writing by the Owner/Engineer, transformers shall be trapeze mounted using properly sized Amber/Booth type BRD rubber-in-shear hangers. Transformer enclosures shall make no contact with wall surfaces.
- C. Conduit: Conduit directly connected to transformer enclosures shall be flexible liquid tight conduit extending for a minimum of 18-inches and a maximum of 24 inches from transformer enclosure as measured along the conduit centerline. Include a ground wire, size in accordance with NEC, internal in each length of flexible conduit.
- D. Grounding: Ground and bond transformers as a separately derived system unless noted otherwise, refer to NEC 250. Installation of bonding strap or bonding conductor between ground and neutral bus shall be witnessed by the Engineer prior to applying power and terminating secondary conductors.

3.2 TESTING

- A. Insulation Tests: Before energizing, check transformer windings for continuity.
- B. Winding Current: During initial no-load energizing, check current in each primary winding.
- C. Tap Settings: Measure and record load current and voltage of transformers while loaded to verify proper transformer tap settings.
- D. Submittals: Furnish instruments and personnel required for tests. Submit four copies of certified test results to Engineer for review. Reports include transformer tested, date and time of tests, relative humidity, temperature, and weather conditions.

- E. Notification: Notify Engineer in writing of any deviation from manufacturer's pre-shipment test data.

END OF SECTION

SECTION 262413 – SWITCHBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Switchboard work as shown, scheduled, indicated, required, and specified.

1.2 QUALITY ASSURANCE

- A. UL Labels: Provide switchboards UL labeled for service entrance and meeting requirements of UL 891.
- B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB2, "Dead-Front Distribution Switchboards."

1.3 SUBMITTALS

- A. Indicate:
 - 1. Detailed dimensions for equipment foot print, front and side elevations.
 - 2. Conduit entrance locations and requirements and restrictions.
 - 3. Enclosure material, finish, and NEMA classification type.
 - 4. Nameplate legends.
 - 5. Size and number of bus bars
 - 6. Switchboard instrument details.
 - 7. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, withstand ratings, and time current curves of all overcurrent devices and components.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. General Electric Co.
- C. Siemens
- D. Eaton

2.2 MATERIALS AND COMPONENTS

- A. Except as otherwise indicated, provide switchboard manufacturer's materials and components as indicated and as required for a complete installation.

2.3 DEAD-FRONT DISTRIBUTION SWITCHBOARDS

- A. The overcurrent protective device short circuit, coordination and arc flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- B. Provide a factory-assembled, dead-front construction, metal enclosed, self supporting, switchboard of voltage, phase, ampacity, and short circuit interrupting rating and bracing shown.
 - 1. Switchboard shall consist of the required number of front and rear aligned vertical sections bolted together to form one metal enclosed rigid switchboard. The switchboard shall be designed as a free-standing with only front access. Rear and/or side access only where indicated to reduce switchboard depth and where NEC required rear access clearance is available.
 - 2. Switchboard shall include protective devices and equipment shown with interconnections, instrumentation, and control wiring. Small wiring, necessary fuse blocks, and terminal blocks in the switchboard shall be provided. Groups of control wires leaving the switchboard shall be furnished with terminal blocks with numbering strips.
 - 3. Factory installed permanent lock-off provision for pad-locking in the off position for all protective devices.
- C. Enclosure Construction: The switchboard framework shall be fabricated for floor mounting. The framework shall be formed code gauge steel, welded and bolted together to support cover plates, busing, and component devices.
 - 1. Each section shall have an open bottom and individually removable top plates for installation and termination of conduit. Top and bottom conduit areas shall be shown and dimensioned on the shop drawings. Front plates used for mounting meters, selector switches, or other front-mounted devices shall be hinged, with wiring installed and laced, and with flexibility at the hinged side. Closure plates shall be screw removable and small enough for easy handling by one technician.
 - 2. Weatherproof enclosure front door(s) shall be pad-lockable and suitable for the intended environmental conditions. When indicated or specified, rear doors shall also be pad-lockable.
- D. Busing: The switchboard busing shall be copper.
 - 1. The bus bars shall be braced to comply with the integrated equipment rating of the switchboard. The main horizontal bus bars between sections shall be located on the back of the switchboard to permit maximum available conduit entry area. The horizontal main bus bar supports, connections, and joints shall be bolted or welded, as required, so as not to require periodic maintenance. Bolted joint connections shall have at least two bolts per joint per phase. Half lapped bus joint construction is not acceptable.

2. Buses shall be arranged A-B-C, left-to-right, top-to-bottom, and front-to-rear throughout. A ground bus shall be secured to each vertical section structure and extend the entire length of the switchboard.
 3. The main horizontal bus and incoming line shall be isolated and insulated from outgoing busing and cable connections.
 4. Each group mounted section shall have maximum full height bus. Where space is indicated, space shall be used to install future switches or future circuit breakers sized as shown or a 600 Amp frame size circuit breaker or switch, whichever is greater.
 5. The main horizontal bus shall be non-tapered, fully rated, extended and drilled for future additions and splice plates.
- E. Integrated Equipment Rating: Each switchboard, as a complete unit, shall be given a single integrated equipment rating by the manufacturer. The integrated equipment short circuit rating shall certify that equipment can withstand the stresses of a fault equal to that shown in RMS symmetrical amperes. Ratings shall have been established by actual tests by the manufacturer on similar equipment construction as the subject switchboard. This test data shall be available and furnished, if requested, with or before the submittal of shop drawings.
- F. Indicating Instruments: Switchboard instrumentation shall be digital display, panel mounted, rated for 120V, 60 hertz. The display unit shall be UL listed in accordance with UL 508. The electronic metering device shall have the following features:
1. Voltmeter, phase to phase and phase to ground or neutral.
 2. Current, per phase RMS and 3 phase coverage.
 3. Demand current per phase.
 4. Power factor per phase and 3 phase average.
 5. Real power, 3 phase total.
 6. Reactive power, 3 phase total.
 7. Apparent power, 3 phase total.
 8. Frequency.
 9. Average demand real power.
 10. Adjustable demand interval (5 to 60 minutes).
 11. Nonvolatile memory.
 12. Password protected set-up and reset.
 13. 3 current transformers with primary to match bus size and 5 ampere secondary with metering class accuracy.
 14. Full scale readouts with the following accuracy:

a. Current and voltage measurement	+/-0.1%
b. Power and energy	+/-0.2%
c. Frequency	+/-0.5%
d. Power Factor	+/-1.0%
e. Data update time	0.5 seconds (4 wire)
 15. Metering Output.
 - a. Pulse output based on kWh, kvarh, or kVAh.
 - b. Analog output 4-20mA based on kWh, kvarh, or kVAh.
 16. Monitoring:
 - a. Harmonic analysis through 63rd with THD and TIF.
 - b. Event recorder.
 - c. Waveform capture.

- d. Data logger.
 - e. Triggered trace memory.
 - 17. Communication:
 - a. Front port and dual rear mounted RS485 ports.
 - b. BACnet protocol (coordinate with BMCS contractor).
 - c. Mini RTU: digital 4 in/4 out.
 - d. Analog 1 in/4 out.
 - e. Local/remote display of all values.
 - 18. Software:
 - a. Windows based software shall be provided to enable setpoint programming.
- G. The Main Protective Device(s) shall be individually mounted molded case circuit breaker(s):
 - 1. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state true RMS sensing, without fusible elements, 100-percent continuous current rating.
 - 2. Main protective devices with frame rated at 1000 Amps or greater shall have integral ground fault interrupter and provided with a portable test set or test switch.
 - 3. Circuit breakers with 1,200 Amp frame and above shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - 4. Provide shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
- H. Feeder and Branch Protective Devices greater than 1,200 Amps shall be individually mounted:
 - 1. Molded case circuit breakers:
 - a. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
 - b. Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
 - 2. Fusible switches:
 - a. Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - b. Fused switches 600 Amps and below, equipped for class J fuses.
 - c. Fused switches 601 Amps and above shall be equipped with Class R or L rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.
 - d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- I. Feeder and Branch Protective Devices 1,200 Amps and below shall be group mounted:

1. Molded case circuit breakers:
 - a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - b. 250 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - c. 1,200 Amp frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 2. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. 601 Amps and above shall be equipped for Class R or L rejection type fuse holders.
 - e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- J. Ground Fault Interrupter (GFI) protection: Where shown or required, ground fault protection shall be achieved with adjustable pickup for ground fault currents, field-adjustable from 200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system shall include necessary current sensors, internal wiring, and relays to coordinate opening the monitored faulted circuits.
1. Ground fault protection shall be set at minimum setting for both current and time during construction. The switchboard manufacturer shall include in the submittal data for the switchboard, the minimum setting of the devices and the recommended setting for normal building operation.
 2. The ground fault system shall be factory-tested before shipment as specified:
 - a. The switchboard manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the sensors and measure the tripping time for each phase and neutral. The measured time-current relationships shall be compared to the trip-characteristic curves. If the ground fault device trips outside the range of values indicated on the curve, the ground fault device shall be replaced or recalibrated.
 - b. Relays, electrically operated switches, shunt-trip switches, circuit breakers, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.
 - c. Upon completion of the factory ground fault protection system test, the current and time on each ground fault device shall be set to minimum values.

- K. Mimic bus: Indicate busing, connections, and devices in single line form on the front panels of the switchboard using red colored plastic strips, fastened flat against the panel face with screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHBOARDS

- A. Install switchboards where shown, in accordance with the manufacturer's written instructions, and industry practices to ensure that the switchboards meet the specifications. Provide weatherproof NEMA 3R enclosure housing outdoors, at wet locations, or where indicated on the drawings. Provide NEMA 3RX enclosure housing at corrosive locations of either aluminum or stainless-steel construction suitable for the intended environment when indicated on the drawings.
- B. Comply with the requirements of NEMA and NEC, and NECA Standard of Installation, for installation of switchboards.
- C. Where switchboard is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building's grounding system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the switchboard.
- D. Torque bus connections and tighten mechanical fasteners.
- E. Install fuses, of ratings shown, in each switchboard. Provide spare fuse cabinet with three fuses of each size provided. Locate in central plant as directed by Owner.
- F. Concrete Pads: Install switchboards on a 4" reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the switchboard unless shown otherwise. Switchboard shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers. Furnish the exact position of any block outs, dimensions, and location of the housekeeping pads to prevent delay of the concrete work.
- G. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as recommended by the Fault Current and Coordination Analysis or as directed by the Engineer.
- H. Indicating Instruments: Provide initial factory start-up and programming with Owner present. Integrate with the Building Management System for monitoring and logging of all system data.

3.2 TESTING

- A. Notify Owner's Commissioning Authority (CxA) prior to performing any tests so that the CxA may witness tests at the CxA's discretion.
- B. Pre-energization checks: Before energizing, check switchboards for continuous of circuits and for short circuits.

- C. Switchboard insulation resistance test: Each switchboard bus shall be insulation resistance tested after installation is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-ground. Minimum acceptable value for insulation resistance is 2 megohms.
- D. Ground Fault Interrupter (GFI) test: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50 percent of overcurrent device rating or 1,200 Amperes, whichever is lower.
- E. Submittals: Furnish instruments and personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

3.3 TRAINING

- A. Provide minimum 2 hours of dedicated training provided by a factory authorized representative to Owner's personnel regarding programming, operating, and use of switchboard components including all indicating instruments and safety features.

END OF SECTION

SECTION 262414 - TESTING, MAINTENANCE, AND MODIFICATIONS TO EXISTING
SWITCHBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Switchboard work to existing switchboards 600 volts or less as shown, scheduled, indicated, and specified.
- B. Types: Switchboard work for the project includes power distribution switchboards.

1.2 QUALITY ASSURANCE

- A. Original Manufacturer's Installation and Maintenance Instructions
- B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB2, "Dead-Front Distribution Switchboards."

1.3 SUBMITTALS

- A. Indicate Original Manufacturer's Installation and Maintenance Instructions for testing, exercising, cleaning, and lubrication where available.
- B. Include electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time current curves of all new equipment and components.
- C. Original Manufacturer's Inspection Report

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Replacement parts shall be manufactured by Original Equipment Manufacturer, (OEM) when available. When OEM parts are not available, third party, UL recognized, manufactured parts shall be used. Provide written confirmation on Manufacturer's letterhead indicating OEM parts are not available.

2.2 MATERIALS AND COMPONENTS

- A. Except as otherwise indicated, provide switchboard manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended, and as required for a complete installation.

2.3 DEAD-FRONT DISTRIBUTION SWITCHBOARDS-NEW SWITCHBOARD SECTIONS AND/OR ACCESSORIES

- A. New Indicating Instruments where indicated: Switchboard instrumentation shall be digital display, panel mounted, rated for 120V, 60 hertz. The display unit shall be UL listed in accordance with UL 508. The electronic metering device shall have the following features:
1. Voltmeter, phase to phase and phase to ground or neutral.
 2. Current, per phase RMS and 3 phase coverage.
 3. Demand current per phase.
 4. Power factor per phase and 3 phase average.
 5. Real power, 3 phase total.
 6. Reactive power, 3 phase total.
 7. Apparent power, 3 phase total.
 8. Frequency.
 9. Average demand real power.
 10. Adjustable demand interval (5 to 60 minutes).
 11. Nonvolatile memory.
 12. Password protected set-up and reset.
 13. 3 current transformers with primary to match bus size and 5 ampere secondary with metering class accuracy.
 14. Full scale readouts with the following accuracy:
 - a. Current and voltage measurement $\pm 0.1\%$
 - b. Power and energy $\pm 0.2\%$
 - c. Frequency $\pm 0.5\%$
 - d. Power Factor $\pm 1.0\%$
 - e. Data update time 0.5 seconds(4 wire)
 15. Metering Output.
 - a. Pulse output based on kWh, kvarh, or kVAh.
 - b. Analog output 4-20mA based on kWh, kvarh, or kVAh.
 16. Monitoring:
 - a. Harmonic analysis through 63rd with THD and TIF.
 - b. Event recorder.
 - c. Waveform capture.
 - d. Data logger.
 - e. Triggered trace memory.
 17. Communication:
 - a. Front port and dual rear mounted RS485 ports.
 - b. BACnet protocol (coordinate with BMCS contractor).
 - c. Mini RTU: digital 4 in/4 out.
 - d. Analog 1 in/4 out.
 - e. Local/remote display of all values.
 18. Software:
 - a. Windows based software shall be provided to enable setpoint programming.
- B. New Feeder and Branch Protective Devices where indicated or required, greater than 1,200 Amps shall be individually mounted:
1. Molded case circuit breakers:

- a. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
 - b. Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
 - 2. Fusible switches:
 - a. Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - b. Fused switches 600 Amps and below, equipped for class J fuses.
 - c. Fused switches 601 Amps and above shall be equipped with Class R or L rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.
 - d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- C. Feeder and Branch Protective Devices 1,200 Amps and below where indicated or required shall be group mounted:
- 1. Molded case circuit breakers:
 - a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - b. 250 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - c. 1,200 Amp frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - 2. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. 601 Amps and above shall be equipped for Class R or L rejection type fuse holders.
 - e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

PART 3 - EXECUTION

3.1 INSTALLATION, MAINTENANCE, AND MODIFICATION OF SWITCHBOARDS

- A. Comply with the requirements of NEMA and NEC, and NECA Standard of Installation, for installation of switchboards. Comply with Original Manufacturer's Operation and Maintenance Instructions for testing and periodic maintenance.
- B. Torque all existing and new bus connections and tighten mechanical fasteners to manufacturer's specifications.
- C. Install fuses, of ratings shown, in each new or modified fused switch.
- D. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as directed by the OEM for coordination with downstream overcurrent devices.
- E. Existing Indicating Instruments: Test and calibrate to original manufacturer's specifications. Replace batteries in existing digital instruments where batteries are required. Replace defective indicating instruments with new digital instruments. Provide new digital indicating instruments where indicated on the drawings.
- F. Cleaning: Vacuum the interior of the existing switchboard enclosures of all dust and foreign matter. Clean all existing switch contacts according to manufacturer's instructions.
- G. Lubrication: Lubricate all existing exposed switch contacts, pivot points and bearings according to manufacturer's instructions.
- H. Remove any existing circuit breakers or fusible switches that are not functional or not suitable to be reused as "spares".
- I. Provide filler plates where required.
- J. Existing switchboards which indicate rust or corrosion shall be repainted; paint indoor switchboards with ALKYD enamel coat, and outdoor switchboards with epoxy enamel coat to match existing color. Do not paint over labels or listings.
- K. Mimic bus: Update the existing mimic bus or provide new mimic bus to indicate busing, connections, and devices in single line form on the front panels of the switchboard using red colored plastic strips or match exiting material and color format, fastened flat against the panel face with screws.

3.2 TESTING

- A. Provide the services of the Original Manufacturer's Field Services personnel for initial testing at no additional cost to the Owner. The Original Manufacturer's Field Services personnel shall provide at minimum, a visual inspection of the existing switchboards and shall provide a written report on the Original Manufacturer's letter head with

recommendations regarding the existing condition and recommendations to further testing, maintenance, and in regard to the specified modifications of the existing switchboard. The report shall include any deficiencies of the existing switchboard in relation to each component's intended function. In addition, provide deficiencies of the existing switchboard with regard to the current National Electrical Code. Provide the written report to the Architect within 14 days of notice to proceed and prior to any demolition or construction. All other testing, maintenance, and modifications shall be provided by the Contractor as specified at no additional cost to the Owner.

- B. Pre-Energization Checks: Before energizing, check switchboards for continuous of circuits and for short circuits. Test existing Bolted Pressure Switches according to Original Manufacture's Instructions.
- C. Switchboard Insulation Resistance Test: Each switchboard bus shall be insulation resistance tested after installation and modification is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-ground. Minimum acceptable value for insulation resistance is 2 megohms.
- D. Ground Fault Protection System Test: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50 percent of the largest overcurrent device rating in the switchboard. Ground fault setting shall not exceed 1200 amperes.
- E. Provide thermal infrared scan of the existing switchboard under full load prior to testing/maintenance and modifications and of the modified and new switchboard sections after construction as directed and witnessed by Owner. Provide digital video disc (DVD) documentation with test results for comparison between prior condition and post construction modifications and future tests.
- F. Submittals: Furnish instruments and personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 262416 - PANELBOARDS AND ENCLOSURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Standards: Panelboards and enclosures shall confirm to all applicable UL standards and shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. General Electric Co.
- C. Siemens
- D. Eaton

2.2 MATERIALS AND COMPONENTS

- A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and as required.
- B. The overcurrent protective device short circuit, coordination and arc flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- C. Busing Assembly: Panelboard phase, neutral, and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Neutral bus termination quantity for branch circuit panelboards shall match or exceed the maximum number of single pole circuit breakers the panelboard will accept.

- D. Main circuit breakers and feeder / branch circuit breakers:
1. Less than 125 Amps: Thermal magnetic with factory fixed trip.
 2. 125-600 Amps: Thermal magnetic with adjustable instantaneous trip of 5X – 10X with short time tracking.
 3. 601 Amps and larger: Solid state true RMS sensing with adjustable: current set by rating plug or adjustable dial, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 4. Provide permanent lock-off device where indicated or required for circuit breaker to be used as a remote safety disconnect switch.
 5. General requirements:
 - a. Make prepared space provisions for additional breakers or fused switches so that no additional bus or connectors will be required to add circuit breakers or fused switches in the available device mounting space.
 - b. Two and three pole breakers shall have internal common trips.
 - c. All circuit breakers used as the main or branch mounted back-fed main shall be bolt-on. All circuit breakers used in 600 Amp and smaller panelboards shall be bolt-on breakers. Circuit breakers for distribution panelboards rated 601 amps and larger shall have plug-on or bolt-on circuit breakers.
 - d. Branch circuit panelboard shall have interrupting capacity as shown or as required, but in no case less 10k AIC for 120/208/240-Volt systems, and 18k AIC for 277/480-Volt systems.
 - e. 15 and 20 Amp circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
 - f. Personnel ground fault interrupter (GFI) circuit breakers, where shown, shall be maximum 5 mA ground fault trip and shall include a TEST button.
 - g. Equipment ground fault interrupter (EGFI/EGPD) circuit breakers, where shown or required shall be 30mA ground fault trip and shall include TEST button.
 - h. Circuit breakers with 1,200 Amp and larger frame shall have Energy Reducing Maintenance Switching with local status indicator (ERMS).
- E. Fusible Switches for distribution panelboards: Fusible switches shall be quick-make, quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Interlock cover with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be overridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the OFF position. Switches shall include positive pressure rejection type fuse clips for use with UL Class J fuses and be UL labeled for 200,000 AIC.
- F. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.
- G. Integrated Equipment Rating: Do not apply series ratings. Each panelboard, as a complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed.

H. Panelboard Enclosures:

1. Provide sheet steel enclosures, minimum 16-gauge nominal thickness, with multiple knockouts, unless shown otherwise. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key, panelboard enclosures keyed alike to match the Owner's standard key system; coordinate with Owner.
2. All NEMA 1 enclosure panelboards shall be hinged "door-in-door" type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right. Manufacturer hardware (OEM), screws, and bolts shall be used to secure dead fronts and covers. Do not use third party hardware. Do not use power tools to secure panel hardware. Provide gray powder coat finish over a rust inhibitor.
3. Equip with interior circuit directory frame, card, and clear plastic covering for panelboards.
4. Panelboards located in kitchen preparation or natatorium areas shall have Type 316 stainless steel front, door, and trim with a NEMA 1 rating for the entire enclosure.
5. Panelboards at exterior locations shall be NEMA 4X Type 316 stainless steel.
6. Panelboards at hose down areas, cooling towers, in greenhouses, and other corrosive locations shall be NEMA 4X 316 stainless steel.
7. Enclosure shall be for recessed or surface mounting as shown or as required.
8. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES

- A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.
- B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.
- C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.
- D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office, etc.) Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7).

- E. Fuses: Install fuses, of the ratings and class shown.
- F. Circuit Arrangement: Branch circuits shall be arranged to provide the best possible phase balance, unless shown otherwise.
- G. Panelboards not intended to be used as service entrance (SE) rated or for establishing a separately derived neutral system shall have the factory installed neutral to ground bonding screws and straps removed and disposed of.
- H. Recessed or flush mounted panelboards: Terminate spare conduits in junction box 18-inches above accessible ceiling close to panelboard location. Label junction box cover as “not used” and include panel identification.
 - 1. Provide (3) 1-inch and (3) ¾-inch spare conduits above accessible ceiling to j-box from each panelboard section.
 - 2. Where recessed panelboard is located above another building floor, also provide (3) 1-inch and (3) ¾-inch conduits to j-box in ceiling space on floor below.
- A. Conductors shall be bent neatly opposite the fuse switch or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Panelboard shall be cleaned of all construction debris prior to substantial completion review. Neutral and grounding conductors shall be installed similar to the phase conductors.
- B. Circuit breakers and conductors installed for SPD devices shall be located at the top or bottom of the panelboard in respect to the location of the SPD device. Route all conductors to the SPD device with straight as possible run, using longest sweep bends and the shortest conductor length possible. Twist all SPD conductors and secure with tie straps wherever possible.
- C. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to panelboard enclosure with mechanical lugs and not to ground bus.
- D. Install panels so that breaker number 1 is the top left breaker.
- E. In panels that contain multi-layered neutral bus, install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.
- F. Label breaker mounting space with stick-on number labels.
- G. Mount the fully aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78-inches. Mount panelboards as high as practical and such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.2 TESTING

- A. Before energizing, energization, check for continuity of circuits and short circuits.

END OF SECTION

SECTION 262430 - FUSES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Fuse work as shown and scheduled, and as specified.
- B. Types: Fuses required for the project include the following:
 - 1. 250 volt current limiting fuses
 - 2. 600 volt current limiting fuses

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by Bussman or Littlefuse.

2.2 CURRENT LIMITING FUSES - 600 VOLTS AND LESS

- A. General: Provide 200,000 amperes interrupting capacity (AIC) current-limiting fuses of the current ratings shown and voltage rating equal to or greater than the voltage at the point of application.
- B. Types:
 - 1. Fuses in circuits supplying individual motors, groups of motors, or loads including motors, 600 amperes or less, shall be UL Class RK1 or Class J, time delay fuses, Bussman LPS-RK (600V) LPJ-SP (600V), LPN-RK (250V).
 - 2. Fuses in circuits supplying individual motors, groups of motors, or loads including motors, 601 to 4000 amperes, shall be UL Class L time delay fuses, Bussman KRPC "HI-CAP".
 - 3. Fuses in circuits supplying other than motor loads, 600 amperes or less, shall be UL Class RK1, time delay fuses, Bussman LPS-RK (600V), LPN-RK (250V).
 - 4. Fuses supplying surge protection devices (SPD) shall be surge rated for use with SPD devices.

2.3 SPARE FUSES

- A. General: Provide spare fuses in the amount of 10% of each type and size installed, but not less than 3 spares of a specific size and type. Deliver to the Owner at the time of project acceptance. Fuses shall be encased in a labeled steel enclosure with padlock provision, to be wall mounted where directed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install fuses in fuse holders immediately before energizing of the circuit where the fuses are installed. Fuses shall not be installed and shipped with equipment.
- B. Labels: Place fuse identification labels, showing fuse size and type installed, inside the cover of each switch.

END OF SECTION

SECTION 264300 - SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION/SCOPE

- A. The Surge Protection Device (SPD) covered under this section includes all service entrance type surge protection devices suitable for use as Type 1 or Type 2 Devices per UL1449 4th Edition, applied to the line or load side of the utility feed inside the facility. The unit shall be connected in parallel with the facility's wiring system. The unit shall be manufactured in the USA by a qualified manufacturer of suppression filter system equipment, which has been engaged in the commercial design and manufacture of such products for a minimum of five years.
- B. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to finish and install surge protection devices.

1.2 QUALITY ASSURANCE

- A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
 - 1. UL 1449 Fourth Edition
 - 2. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - 3. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
 - 4. IEEE 1100 Emerald Book.
 - 5. National Fire Protection Association (NFPA 70 (NEC), 75, and 78).
 - 6. UL 1283 – Electromagnetic Interference Filters

1.3 SUBMITTALS

- A. Submit shop drawings complete with all technical information unit dimensions, detailed installation instructions, maintenance manual, and wiring configuration.
- B. Copies of Manufacturer's catalog data, technical information and specifications on equipment.
- C. Copies of documentation stating that the Surge Protection Device is listed from a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, etc) and are tested and multi-listed to UL 1449 4th Edition and UL 1283.
- D. Copies of actual let through voltage data in the form of oscilloscope results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.
- E. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the ANSI/IEEE C62.41

impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.

- F. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.
- G. Provide detailed marked-up copy of this specification with line-by-line compliance or exception statements to all provisions of this specification.

1.4 WARRANTY

- A. The manufacturer shall provide a minimum 10-Year warranty for parts from date of substantial completion against failure. Contractor shall install in compliance with applicable national / local electrical codes and the manufacturer's Installation, Operation and Maintenance Instructions.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURER

- A. Low exposure, minimum 50k Amps per mode, 100k Amps per phase, Type 1 and Type 2
 - 1. Branch panelboard extensions for recessed mounting: Current Technology PX3-50 series; ASCO LPGE-65 Series; PSP 4000-HXC 100 Series. Brushed stainless steel front in kitchen and food processing areas.
 - 2. Branch panelboard surface mounted: Current Technology CGC50 series; ASCO 330XX 05 (Indoor only) Series; PSP 4000-HXC100 Series.
- B. Medium exposure, minimum 120k Amps per mode, 240k Amps per phase, Type 1 and Type 2.
 - 1. Current Technology CGP120 series; ASCO 570YX12 Series; PSP 4000-HXC300 Series.
- C. High exposure, minimum 200k Amps per mode, 400k Amps per phase, Type 1 and 2 SPD
 - 1. Current Technology CGP200 series; ASCO Power 570YX20 Series; PSP 5000-HXC 400 Series.

2.2 MANUFACTURED UNITS / ELECTRICAL REQUIREMENTS

- A. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% overvoltage test in UL1449 will not be accepted.
- B. Unit shall have not more than 10% deterioration or degradation of the UL1449, Voltage Protection Rating (VPR) due to repeated surges.
- C. Protection Modes SVR (6kV, 500A) and UL1449 VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in

UL1449 section 37.6: Values Depicted are based on a system Without Disconnect / With Disconnect

System Voltage	Mode	MCOV	C3 Wave	UL 1449 VPR Rating
120/240	L-N	150	650/775	700/800
120/208	L-G	150	650/825	700/900
	N-G	0	500/500	900/1000
	L-L	300	950/1250	900/1200
277/480	L-N	320	1125/1225	900/1200
	L-G	320	1075/1225	1200/1200
	N-G	0	900/900	1200/1500
	L-L	550	1950/2200	1800/1800

- D. Electrical Noise Filter- each unit shall include a high performance EMI/RFI noise rejection filter. Noise attenuation for electric noise shall be as follows using the MIL-STD-220A insertion loss test method.
1. 33 db from 10kHz to 100MHz
 2. All other frequencies should be 31 db or better.
- E. Each Unit shall provide the following features:
1. Phase Indicator lights, Form C dry contacts, counter and audible alarm.
 2. Field testable while installed.
 3. High performance interconnecting cable.
 4. The UL 1449 Voltage Protection Rating (VPR) shall be permanently affixed to the SPD unit.
 5. The UL 1449 Nominal Discharge Surge Current Rating shall be 20Ka
 6. The SCCR rating of the SPD shall be 200kAIC without requiring an upstream protection device for safe operation.
 7. The unit shall be listed as a Type 1 SPD, suitable for use in both Type 1 and Type 2 locations per UL1449.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall not be any longer than necessary, avoiding unnecessary bends. Minimum wire size and overcurrent protection shall be provided and as indicated or recommended by the manufacturer.
- B. Units specified for lighting and appliance panel boards as panelboard extensions (EGPE) shall be mounted directly above or below the first section of the panel board it is protecting. Any other mounting location will not be acceptable and shall be corrected, without exception, at no additional cost to the Owner.

- C. Units specified for panelboards, switchboards, or motor control centers shall be mounted directly above or adjacent to the panelboard, switchboard or motor control center using unistrut supports secured to structure as required. Conduit length between power distribution panelboard or switchboard shall be less than two-inches. Mounting above equipment is not acceptable.
- D. Overcurrent device and conductors for devices shall be the maximum recommended by the manufacturer. Manufacturer's recommendations shall prevail over the information given in the plans and specifications.
- E. Provide recessed mounted panelboard extension type enclosures for devices protecting recessed panelboards. Enclosure front shall match panelboard front. Provide brushed stainless steel front at kitchens and food processing areas.

3.2 TESTING

- A. Factory Trained Representative shall provide start-up to include initial verification of proper installation and initiate factory warranty. The technician will be required to do the following as a minimum:
 - 1. Verify overcurrent device rating
 - 2. Verify all wiring connections and installation conforms to manufacturer's recommendations.
 - 3. Record information for each product installed and include in O&M Manual
- B. A copy of the Factory diagnostic test report and digital format approval of the installation shall be included with the Electrical Operating and Maintenance Manual. The Contractor shall make all adjustments, changes, corrections, etc. as required by the Factory Trained Representative so that the installation is in compliance with the manufacturer's installation and operation instructions without additional charge to the Owner.

END OF SECTION

SECTION 265113 - LIGHTING FIXTURES AND LAMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Lighting fixture work is as shown, scheduled and specified.
- B. Applications: The applications of lighting fixtures required for the project include the following:
 - 1. Interior and exterior lighting fixtures
 - 2. Emergency lighting
 - 3. Exit signs
 - 4. Lighting controls and accessories.

1.2 QUALITY ASSURANCE

- A. Provide interior building LED fixtures that comply with the Design Lights Consortium (DLC) standards and are DLC listed as a Qualifying Product at time of proposal submittal date.
- B. UL Standards: Lighting fixtures shall conform to applicable UL standards and be UL or ETL labeled.
- C. Light fixtures shall conform to the requirements of NFPA 101, and 70 (NEC).

1.3 SUBMITTALS

- A. Submit product data for light fixtures, and emergency lighting equipment.
- B. Specification Compliance Review: Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by manufacturers shown or scheduled for each type of lighting fixture. Refer to drawings for approved light fixture manufacturers.
 - 1. Emergency Battery Packs:
 - a. Bodine
 - b. IOTA
 - c. Chloride

- d. Lithonia
- e. Dual Lite

2.2 MATERIALS AND COMPONENTS

A. General: Provide lighting fixtures of the size, type, and rating indicated, complete with,

1. Fixture Types:

a. General:

- 1) Lay-in troffer fixture panel type lenses, where specified, shall be extruded virgin acrylic, prismatic type minimum 0.125" thick, 7.8-ounces per square foot minimum.
- 2) Fixtures in continuous rows shall be supplied with fixture couplings, chase nipples, and accessories recommended by the manufacturer for continuous row installation.
- 3) Safety chains and wire guards at fixtures in mechanical and electrical rooms, gymnasiums and high abuse areas.
- 4) Fixtures located outdoors, in interior unconditioned spaces, and in wet locations shall be of aluminum construction.
- 5) Fixture door frame shall be of aluminum construction, white finish where located in kitchens, food prep areas, toilets, restrooms, locker rooms, dressing rooms, showers, and unconditioned spaces.
- 6) DLC or Energy Star qualified unless specified otherwise.
- 7) Minimum 5-year replacement warranty for driver and light engine.
- 8) Outdoor fixtures shall include a discrete / replaceable surge suppression device in addition to the surge suppression incorporated in the LED driver.
- 9) Operating temperature rating shall be between -40 degrees F and 120 degrees F.
- 10) Color Rendering Index (CRI): ≥ 80 Indoor; ≥ 65 Outdoor
- 11) The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).

- b. Downlight Fixtures: Provide recessed downlight fixtures with trim rings compatible with the ceiling material where fixture is to be installed. Downlight fixtures shall have a minimum efficiency of 65-percent and exhibit "lamp before lamp image" 45-degree cutoff for ceiling up to 10 feet.
- c. LED Exit Signs: The exit lighting fixtures shall meet the requirements of Federal, State, and Local Codes.
- d. Emergency Lighting Units: Lead Calcium batteries with self-diagnostics. Provide full light output at 90 minutes of battery operation. LED lamps.

B. LED drivers:

1. NEMA 410 compliant for in-rush current.
2. Drivers shall have a minimum efficiency of 85%.
3. Starting Temperature: -40° F [-40° C].
4. Input Voltage: 120 to 480 ($\pm 10\%$) V.
5. Power Supplies: Class I or II output.

6. Surge Protection: The system must survive 250 repetitive strikes of “C Low” (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. “C Low” waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 7. Power Factor (PF): ≥ 0.90 .
 8. Total Harmonic Distortion (THD): $\leq 20\%$.
 9. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 10. Drivers shall be reduction of hazardous substances (ROHS)-compliant.
- C. Voltage: Equipment for use on 120V systems shall be suitable and guaranteed for voltage range of 100V to 130V. Equipment on 277V systems shall be suitable and guaranteed for voltage range of 225V to 290V. Universal voltage equipment shall be suitable and guaranteed for a voltage range of 100V to 290V.
- D. Light fixture housing for exterior use: Provide aluminum or stainless housing. Where stainless steel hardware is used, both male and female fasteners shall be stainless steel.
- E. Emergency LED battery self testing drivers and inverters; 5 year warranty.
1. Bodine BSL-ST Series for OEM installation
 2. Bodine BSL310-SI Series for field installation
 3. Bodine ELI-S Series for line voltage sine wave inverter field installation
- F. Emergency Battery Packs – Exit Signs: Nickel Cadmium battery with self- diagnostics; Minimum 3-year non-prorated replacement warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install lighting fixtures of the types indicated, where shown, and at indicated heights in accordance with the fixture manufacturer's written instructions and industry practices to ensure that the fixtures meet the specifications. Fixtures shall fit the type of ceiling system scheduled.
- B. Standards: Comply with NEMA standards, applicable requirements of NEC pertaining to installation of interior lighting fixtures, and with NECA Standard of Installation.
- C. Attachment: Fasten fixtures to the indicated structural support members of the building. Provide four separate wire supports for recessed ceiling mounted lighting fixtures, one at each corner of fixture. Check to ensure that solid pendant fixtures are plumb. Provide T-bar locking clips on all four sides for lay-in fixtures.
- D. Coordination: Field coordinate and locate lighting fixtures in open ceiling areas including mechanical and electrical rooms so that light is not obstructed by piping, ductwork, etc. Locate light fixtures in front of electrical and mechanical equipment to provide adequate illumination for testing and maintenance. Relocate installed light fixtures as directed by Owner / Architect at no additional cost.
- E. Final adjustment of all aimable exterior light fixtures shall be in coordination with, and to the satisfaction of, the Owner's designated representative. Pre-aim all fixtures prior to scheduled

final aiming and adjustment with Architect / Owner. Verify that all rotatable optics are in their proper orientation prior to final aiming.

- F. Provide exit sign directional arrows as required. Provide a minimum of two and a maximum of 10% spare exit signs to be installed as directed by Architect.
- G. Install in accordance with manufacturers instructions.
- H. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminary at indicated height.
- I. Locate recessed ceiling luminaries as indicated on the Architectural reflected ceiling plan.
- J. Install surface mounted luminaries plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- K. Exposed Grid Ceilings: Support surface mounted luminaries on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling Ts to support surface mounted luminaries. Fasten surface mounted luminaries to ceiling T using bolts, screws, rivets, or suitable clips.
- L. Install recessed luminaries to permit removal from below.
- M. Install recessed luminaries using accessories and fire stopping materials to meet regulatory requirements for fire rating.
- N. Install wall-mounted luminaries at height as directed by Architect.
- O. Install accessories furnished with each luminary.
- P. Connect luminaries to branch circuit outlets using flexible conduit as specified.
- Q. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaries.
- R. Bond products and metal accessories to branch circuit equipment grounding conductor.
- S. Provide un-switched, constant-hot circuit to all battery powered emergency lighting equipment and emergency transfer devices (GTD). Where normal light fixture circuit is switched or contactor controlled, non-switched battery charging or GTD circuit shall originate from same branch circuit breaker as switched lighting circuit.
- T. Provide emergency powered light fixture in front of all electrical switchgear, including but not limited to panelboards, switchboards, motor control centers, low voltage control panels, transfer switches, motor controllers and disconnect switches.
- U. Provide emergency battery operated light fixtures at all transfer switch locations and at all central battery emergency lighting inverters.
- V. Provide automatic controls for exterior light fixtures. Exterior building mounted light fixtures shall be circuited through lighting contactors. Lighting contactors shall be controlled by the

Building Management System. Where no building management system is provided or specified, provide time clock switches, photocells, photosensors as specified, and required by the local energy codes.

- W. Lighting contactors shall not be installed above ceiling and shall be readily accessible, located in same room as panelboard serving load.
- X. Wall mounted light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable. Where wall mounted fixtures attach to junction box only, firmly secure junction box to adjoining studs in wall.
- Y. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
- Z. Hardware for surface mounting fixtures to suspended ceilings:
 - 1. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4 inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
 - 2. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 1/4 inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4 inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.

3.2 TESTING

- A. General: Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and proceed with retesting.
- B. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operations. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts.
- C. Final aiming and Adjustment: Aim and adjust aimable and adjustable lighting fixtures for their intended purpose. Re-aim and re-adjust as required to the satisfaction of the Architect / Owner, including nighttime adjustment of exterior lighting in the presence of the Architect / Owner.

END OF SECTION

SECTION 280510 - CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:

1. Field conditions.
2. Condition of installation.
3. Quality of workmanship.
4. Start-up of equipment.
5. Testing and adjusting of equipment.

- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect / Engineer.

1.7 MOCK UPS

- A. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.
- B. Do not proceed with any work involving a mock-up, until the related mock up has been approved in writing.
- C. Acceptable mock-ups in place shall be retained in the completed work where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

- A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
1. Rough-in
 2. Finish with all appurtenances in place
 3. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

END OF SECTION

SECTION 283102 - EXPANSION OF EXISTING FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide all detailed engineering, documentation, materials and devices, installation, calibration, software programming and check-out necessary for a complete and fully operational fire detection and alarm system in accordance with the full intent and meaning of the drawings and specifications including, but not limited to, the following:
 - 1. Supply, install and connect all hardware necessary to provide a complete and operational fire detection and alarm system.
 - 2. Supply, install and wire all field hardware, power supplies, power circuits, alarm initiating devices, audible and visual alarm devices, auxiliary control relays, signal initiating and signaling devices, conduits, wires, fittings and all accessories required for the system to perform as specified as required. Use and expand the existing fire alarm control panel.
 - 3. Supply, install, debug and test all software required to provide all software functions described in accordance with the full intent and meaning of the drawings and specifications.
 - 4. Coordinate the work specified under this Section with other trades and contractors to assure a complete and fully operational system.
- B. The intent of fire detection and alarm system work is specified in this section and indicated on the drawings. The installing contractor shall design and provide a complete system, meeting the requirement of this section. The Contractor shall provide all fire alarm and initiation devices in new and renovated areas required for a complete system acceptable to all governing authorities. Provide proper spacing and coverage of all devices.

1.2 RELATED SECTIONS

- A. Divisions 22 & 23
- B. Fire Suppression Systems
- C. Food Service

1.3 CODES / STANDARDS / REFERENCES (LATEST EDITIONS)

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 13 Systems, Installation
 - 2. NFPA 17 Dry Chemical Extinguishing Systems
 - 3. NFPA 70 National Electrical Code
 - 4. NFPA 72 National Fire Alarm Code.
 - 5. NFPA 80 Fire Doors and Fire Windows
 - 6. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 7. NFPA 92A Smoke Control Systems

8. NFPA 101 Life Safety code.
 9. NFPA 105 Smoke Control Door Assemblies
 10. NFPA 2001 Fire Extinguishing Systems, Clean Agent
- B. UL: Underwriters Laboratories, Inc.
1. 217 Single and Multiple Station Smoke Detectors.
 2. 268 Smoke Detectors for Fire Protective Signaling Services.
 3. 864 Control Units for Fire Protective Signaling Services.
 4. 864 Transient protection
 5. 1480 Speakers for Fire Protective Signaling Systems
 6. UL Fire Protection Equipment Directory.
 7. UL Electrical Construction Materials Directory.
- C. Factory Mutual P7825 Approval Guide
- D. American National Standards Institute (ANSI).
- E. National Electrical Manufacturer's Association (NEMA).
- F. Institute of Electrical and Electronic Engineers (IEEE).
- G. Electronic Industries Association (EIA-232-C): Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.
- H. Requirements of American Disabilities Act (Public Law 101-336).
- I. Local Accessibility Standards, Codes, and Ordinances
- J. State Fire Marshall or Requirements of Local Authorities having Jurisdiction
- K. State Insurance Code.
- L. National Building Code.
- M. International Building Code.
- N. Uniform Building Code.
- O. Local & State Building Codes.
- P. In addition the above requirements, comply with all local codes. Where discrepancies exist between codes, drawings or specifications, the more stringent requirement shall prevail. Installation shall be subject to approval, inspection and test of applicable regulatory agencies.

1.4 MANUFACTURER'S, PLANNER'S AND INSTALLER'S QUALIFICATIONS

- A. The manufacturer shall regularly and presently produce, as the manufacturer's principle products, the equipment and material of the type and design specified for this project, and shall have manufactured the item for at least 5 years. All components of the system shall be UL compatible with the existing main fire alarm control panel. Manufacturer of all components shall match

existing manufacturers of similar or same type components unless otherwise specified or noted on the drawings.

- B. The installing contractor shall have been actively engaged in the business of designing, selling, installing, and servicing fire alarm systems for at least ten (10) years.
- C. The entire Fire Detection and Alarm System shall be installed by a factory authorized representative of the existing main fire alarm control panel and certified by the manufacturer to distribute, sell, and install the specified fire alarm and smoke detection system. Include all components, elements, and testing and acceptance procedures.
- D. If the submitted system is being supplied by an authorized distributor of the equipment manufacturer, the distributor shall have been actively engaged in the sale, installation and service of the type of system proposed for this project for a minimum of 10 years.
- E. Any proposed installer who cannot show evidence of such qualifications may be rejected. The services of a technician provided and certified by the equipment manufacturer shall be provided to supervise the installation and tests of the system.
- F. Furnish evidence there is an experienced and effective service organization, which carries a stock of repair parts for the system to be furnished.
- G. The installing contractor shall be licensed by the State Fire Marshall to design, sell, install, and service fire alarm systems as required.
- H. The installing contractor shall have on his staff a minimum of two (2) Fire Alarm Planning Superintendent (APS) licensed by the State Fire Marshall's office for such purpose.
- I. The APS shall be a certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place. In lieu of a NICET certified state licensed fire alarm planner, the contractor or supplier may provide design supervision by a registered professional engineer, who regularly engages in the design of fire alarm systems.
- J. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- K. Material shall be new and in perfect condition when installed.
- L. Electrical or electronic equipment provided under this Division which has been damaged, exposed to weather, or is, in the opinion of the Architect/Engineer otherwise unsuitable because of improper fabrication, storage, or installation, shall be removed and replaced with new equipment, at no additional cost to the owner.

1.5 COORDINATION

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all other trades.

1.6 DEFINITIONS

- A. General: Wherever mentioned in this specification or on the drawings, the equipment, devices and functions shall be defined as follows:
1. Alarm Signal: A signal, which signifies a state of emergency requiring immediate action and immediate notification of the Fire Department. These are signals such as:
 - a. The operation of a manual station.
 - b. The operation of a fire suppression system switch.
 2. Pre-Alarm Signal: A signal, which indicates a detection device, has operated. These signals require and immediate response, but do not require immediate notification of the Fire Department.
 3. Supervisory Signal: A signal, which signifies the impairment of fire protection system, which may prevent its normal operation.
 4. Trouble Signal: A signal, which indicates that a fault, such as an open circuit or ground, has occurred in the system.
 5. Alarm Zone: An alarm initiating device or combination of devices connected to a single alarm initiating device circuit.
 6. Pre-Alarm Zone: A detector or group of detectors connected to a single detector circuit, which can send an alarm to the central control panel.
 7. Supervision Zone: A supervisory signal initiating device or combination of such devices connected to a single supervisory signal circuit.
 8. Communication Zone: A fire alarm indicating device or series of devices arranged to visually and/or audibly indicate a fire alarm signal.

1.7 SUBMITTALS

- A. Before the shop drawings are submitted to Architect / Engineer, submit drawings to the Authority Having Jurisdiction for approval. All approvals shall be noted on the drawings or by letter from the Authority Having Jurisdiction. Submit copies of the Authority Having Jurisdiction approved shop drawings to the Architect for review.
- B. Fire alarm submittal shall be bound and separate from all other submittals. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
1. Provide a complete written, item-by-item, line-by-line, specification review stating compliance or deviation in full description.
 2. Complete point-to-point wiring diagrams of new equipment.
 3. Complete floor plan drawings locating all new system devices and existing panels used for expansion.
 4. Complete system bill of material.
 5. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
 6. Provide a complete description of system operation.
 7. Manufacturer's installation instruction.
 8. Bound form with contractor's name, supplier's name, project name, state fire alarm license, Fire Alarm Planning Superintendent license and all Technician(s) license adequately identified.
 9. Submittal sheets sequentially numbered with the format: sheet number of number total. For example: 1 of 3.

10. Complete set of manufacturer's operating instructions, circuit diagrams and the information necessary for proper installation, operation and maintenance.
11. Field and factory wiring diagrams of all new systems and for typical devices showing all connections with all terminals and interconnections identified.
12. Complete schematic circuit diagrams for all new equipment, including panel modules.
13. Floor plan drawings including all existing main and new panel and device locations, conduit sizes between devices and panels; number, size and type of conductors between devices and panels; walls, doors and graphic room numbers; exact power requirements and conduit routing with the location of all junction boxes and exact locations of devices and equipment. Submit a floor plan drawing circuiting/zoning shall be identified on the drawings.
14. Complete wiring, routing, and schematic diagrams, software descriptions, and details required to demonstrate that the system has been coordinated and will function as a system.
15. Manufacturers catalog cut sheets shall be provide for each piece of equipment with the appropriate model or part number highlighted in cases where multiple model numbers or part numbers are shown.
16. Detailed list of all hardware components, which are included.
17. Installation details for each type of field mounted device installed under this contract.
18. Point-to-point termination schedules with cable identification numbers and terminal strip numbers.
19. New fire detection and alarm system's panel configuration complete with peripheral devices, batteries, power supplies, and interconnection diagrams.
20. Submit a riser diagram of trunk wiring and device-to-device wiring and device to fire alarm control panel wiring. Riser shall show:
 - a. Conduit sizes and types.
 - b. Number, size and type of conductors.
 - c. Fire detection and alarm devices arranged in the required circuiting/zoning, as defined in the specifications and on the drawing.
 - d. Battery calculations to show compliance with the requirements of the specifications for both alarm and supervisory mode.
21. Submit sound and visual level to confirm that number and location of signaling devices will provide required sound and visual levels throughout the building.
22. Sample of proposed graphic/text annunciation.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Submit complete sets of operation and maintenance manuals. Manual, less as-builts, and sign-off sheets, shall be provided upon completion of the work. Approval of the manual will be required prior to substantial completion.
- B. The Operation and Maintenance Manual shall consist of the following:
 1. The manual shall include the names, addresses and telephone numbers of each Contractor installing products, and of the nearest service representative for each product. The manual shall have a Table of Contents and tab sheets. Update manuals to include modifications made during installation, checkout and acceptance. The manual shall include the sections described in the following paragraphs.
 2. The Functional Design Section shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. Hardware and software functions, interfaces, and requirements shall be provided for system operating modes.

3. The Hardware Section shall describe equipment provided, including general description and specifications, installation and checkout procedure, electrical schematics and layout drawings. Alignment and calibration procedures, manufacturer's repair parts list indicating source of supply, interface definition, signal identification and wiring diagrams. Also, include a complete parts list of all components as well as a list of recommended spare parts. The spare parts list shall include, for each item, the manufacturer's name, the model of the part, and serial number, if appropriate, and a physical and electrical description of the part.
4. The Software Section shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software module, to instruct the user on programming or reprogramming any portion of the system and other information necessary to enable proper system usage.
5. The Operation Section shall provide instructions for operation of the system, including system start-up procedures, use of system and applications software, alarm presentation (where applicable), failure and recovery procedures, preventive maintenance schedule, parameter schedules and sequence definition, and system access requirements.
6. The Maintenance Section shall provide descriptions of maintenance for equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
7. The Shop Drawings section shall include copies of all approved shop drawings and submittal materials updated to "AS BUILT".

1.9 AS-BUILT DRAWINGS

- A. Prepare and submit detailed "As-Built" drawings. The drawings shall include certified test of the system, testing and acceptance sign-off sheets, and other items specified elsewhere to be performed after initial submission of operation and maintenance manuals, complete wiring diagrams showing connections between all devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as built location of all devices and equipment. The drawings shall show the system as installed, including all deviations from both the project drawings and the approved shop drawings. The drawings shall be prepared on uniform sized sheets, the same size as the project drawings. The plan drawings shall be 11x17 inch and inserted in the specified Operations and Maintenance Manuals. Provide electronic copies in PDF and Autocad.dwg format.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers acceptable contingent upon Products' compliance with the specifications:
 1. Match Existing main fire alarm panel manufacturer.

2.2 SYSTEM DESCRIPTION

- A. System shall be a fully functional fire detection and alarm system, tested and left in first class operating condition. Voice evacuation systems where required or specified shall have voice alarm notification wherever audible notification is required.

- B. The system shall provide communication with initiating and control devices individually. All of these devices shall be individually annunciated at the fire alarm control panel. Annunciation shall include the following conditions for each point:
 - 1. Alarm
 - 2. Trouble.
 - 3. Open
 - 4. Short
 - 5. Device missing/failed.
- C. System circuits shall be wired as follows: Initiating device circuit (IDCs) shall be Style B, indicating appliance circuit (IACs) shall be Style Y, and signal line circuit (SLCs) shall be Style 4 as describe in NFPA 72.
- D. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.
- E. There shall be supervisory service initiation device circuits for connection of all sprinkler water flow switches and valves. Device activation shall cause a general alarm at the fire alarm control panel. Each flow and tamper switch shall have an individual address.
- F. There shall be independently supervised and independently fused indicating appliance circuits for all alarm signaling devices. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
- G. Auxiliary manual controls shall be supervised so that an “off normal” position of any switch shall cause an “off normal” system trouble.
- H. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the fire alarm control panel. A green “power on” LED shall be displayed continuously while incoming power is present at the building fire alarm control panel.
- I. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the building fire alarm control panel.
- J. The system modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- K. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.
- L. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal or supervisory mode for a period of 24 hours with 20 minutes of alarm operation at the end of this period as a minimum. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. If batteries are fully discharged, the charger shall recharge them back to full charge in four hours.
- M. All external circuits requiring system operating power shall be 24 VDC and shall be individually fused at the respective fire alarm control panel.

- N. All addressable devices shall have the capability of being disabled or enabled individually from the fire alarm control panel.
- O. A maximum of 90 addressable devices shall be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices within the capability of the designed system are unacceptable. Expansion of the designed system shall be accomplished by factory reprogramming.
- P. The communication format to the addressable devices shall be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- Q. Each addressable device must be uniquely identified by an address code. The system must verify that proper type device is in place and matches the desired software configuration. All remote or external panels shall have an individual address for monitoring.
- R. Wiring type, distances, survivability, and wiring configuration types shall be approved by the equipment manufacturer. The system shall allow a line distance of up to 2,500 feet to the furthest addressable device on a Style Y circuit. Fire alarm cable shall have an outer jacket insulation color of red. Minimum wire size shall be #18 AWG.
- S. Each panel extender shall have an individual address.

2.3 FIRE ALARM CONTROL PANEL (FACP)

- A. Existing to be demolished and installed new at new location indicated on drawings.
- B. The fire alarm control panel shall be left with 25% spare initiating point and battery capacity for future use.
- C. New power supplies (if required) shall provide all control panel and peripheral power needs with filtered power as well as unregulated 24VDC power for external audio-visual devices. The audio-visual power shall be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet UL and NFPA requirements for POWER LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits. Design the system power supplies and power trunk wiring for all annunciation devices required, and to add a minimum of two (2) 110cd visual devices in the future. Individual circuit design loading shall not exceed 70% of power supply and system wiring capacity when including the additional spare capacity for the 110cd visual devices
 - 1. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide positive and negative ground fault supervision, battery/charger fail condition, and AC power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.
 - 2. Surge protection shall be integral to the control panels.
 - 3. Each power supply shall be monitored and have an individual address.

2.4 DIGITAL FIRE ALARM COMMUNICATOR

- A. Existing to remain.

2.5 EMERGENCY VOICE ALARM COMMUNICATION SYSTEM

- A. Existing to remain.

2.6 NEW FIELD DEVICES WHERE REQUIRED

- A. All devices shall be supervised for trouble conditions. The fire alarm control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Should a device fail, it shall not hinder the operation of other system devices.
- B. Visual Signals
 - 1. Strobe lights shall be low profile and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA and UL 1638 requirements, and 15, 30, or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Provide white with red letters.
 - 2. All wall mounted strobe units installed in restrooms, gyms, corridors, locker rooms, kitchen preparation and serving areas, and commons areas, shall have a protective cover, STI Stopper #STI1221E Series. Provide enviro kit for locations where dampness, water or dust is present.
- C. Combination Alarm Signal and High Intensity Visual Signals
 - 1. Strobe lights shall be low profile and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Each unit shall provide a Code 3 Temporal tone. The horn shall be capable of an output of 95dB at 10', and intensity adjusted accordingly for the area of coverage. Electronic Mini-Sounder or horn set on low setting shall be provided in interior rooms 900 square feet or less. Mini-sounder shall not be used in any corridors, mechanical electrical rooms and similar large spaces and areas of high ambient noise level. Provide white with red letters.
 - 2. All wall mounted combination units installed in restrooms, gyms, corridors, locker rooms, preparation and serving area, and commons areas, shall have a protective cover, STI Stopper #STI1220E Series. Provide enviro kit for locations where dampness, water or dust is present.
 - 3. The audible emergency alarms shall produce a sound that exceeds the prevailing sound level in the room or space by at least 15 dba or shall exceed any maximum sound level with a duration of 60 seconds by 5 dba, whichever is louder. Sound levels for alarm signals shall not exceed 110 dba at the minimum hearing distance from the audible appliance.
- D. Exterior Audible Signal:
 - 1. Semi-flush mounted, molded of high impact red thermoplastic and listed for weatherproof locations.
- E. Combination Voice Signal and High Intensity Visual Signals (where indicated or required by local AHJ):

1. Strobe lights shall be of the electronic flashing xenon strobe type and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash.
 2. All combination units installed in restrooms, gyms, corridors, locker rooms, preparation and serving area, and commons areas, shall have a protective cover, STI Stopper #STI1220E Series. Provide enviro kit for locations where dampness, water or dust is present.
 3. The visual signal lens housing shall be white with red lettered FIRE or as approved by Architect. The speaker and visual signal shall be mounted to a common white speaker baffle. The visual signal shall flash at a rate of minimum of 1 Hz and maximum of 3 Hz, and shall use a xenon strobe type lamp or other high intensity long life light source. The lamp intensity shall be a minimum of 75 candela.
 4. The speaker shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. High output speakers, UL minimum 87dB at 10 feet with speaker taps of .33.66/1.25/2.5 watts. Standard output speakers, UL 75-81 dB at 10 feet with speaker taps of .5/1/1.75/2.75 watts. Capacitor for line supervision.
- F. Ceiling mounted recessed mounted speakers (where indicated or required by local AHJ) shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. UL minimum 78-87 dB at 10 feet with speaker taps of .25, .5/1.0/2.0 watts. Round, white baffle or 2x2 lay-in grid with UL enclosure, tile bridge supports when recessed in lay-in ceiling tiles (where indicated or required by local AHJ) and capacitor for line supervision.
- G. Surface mounted speakers (where indicated or required by local AHJ) shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F UL minimum 100 dB at 15 watts at 10 feet. Speaker taps via 7-position selector switch, 25-vol., .48/.94/1.8/7.5/15 watts. Fully enclosed wiring terminals. Capacitor for line supervision.
- H. Manual Pull Station: Addressable pull stations shall contain electronics that communicate the station's status (alarm, normal) to the control panel over two wires which also provide power to the pull station. They shall be manufactured from high impact red Lexan with white lettering. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations shall be double action without glass rods. The front of the station shall be hinged to a back plate assembly and shall be opened with a key to reset the station. The key shall be common with the control panels. The addressable manual station shall have address setting programmed electronically and automatically from the fire alarm control panel. Manual stations shall be designed for semi-flush (surface) mounting on standard electrical box. All pull stations units shall have a protective cover, STI Stopper II #STI-1130 surface mounted cover with local alarm horn. Provide STI, Weather Stopper II #STI3150 for locations where dampness, water or dust is present.
- I. Intelligent Multi-Criteria Photoelectric Smoke Detectors
1. The intelligent multi-criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.
 2. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the ANALOG level of

smoke density. The detector shall provide automatic sensitivity "drift" compensation. The detector shall also provide a "maintenance alert" feature whereby the detector shall initiate a trouble condition should the unit's sensitivity approach the outside limits of the normal sensitivity window.

3. The detectors shall provide address setting means electronically and automatically at the control panel.
4. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
5. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base. No radioactive material shall be used.
6. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.

J. Intelligent Photoelectric Smoke Detectors

1. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the ANALOG level of smoke density. The detector shall provide automatic sensitivity "drift" compensation. The detector shall also provide a "maintenance alert" feature whereby the detector shall initiate a trouble condition should the unit's sensitivity approach the outside limits of the normal sensitivity window.
2. The detectors shall provide address setting means electronically and automatically at the control panel.
3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base. No radioactive material shall be used.
5. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.

K. Duct photoelectric smoke detectors:

1. Detectors shall be analog addressable type.
2. To minimize nuisance alarms, detectors shall have an insect screen and be designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive material shall be used.
3. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control panel.
4. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
5. Remote alarm/power LED indicator with test switch shall be provided. Unit shall be wall or ceiling mounted in readily visible and accessible area near the location of detector; exact location of unit to be approved by the Architect/Engineer.
6. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type photoelectric smoke sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the requirement of interface zone modules.

7. The unit shall consist of a clear molded plastic enclosure (or remote mounted LED status indicator shall be provided next to the smoke detector) with integral conduit knockouts to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit's sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination.
 8. The detectors shall provide alarm and power status indication by LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. Steady illumination of the LED shall indicate that the control panel has detected and verified an alarm condition. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 9. The detectors shall provide address setting means electronically and automatically from the control panel.
- L. Intelligent Thermal Detectors
1. The detectors shall use dual electronic thermostats to measure temperature levels in its chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
 2. The detectors shall provide address setting means electronically and automatically at the control panel.
 3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base.
 5. Thermal Detectors shall be combination rate-of-rise and fixed temperature- rated at 135°F for areas where ambient temperatures do not exceed 100°F and shall be 200°F for areas where ambient temperatures exceed 100°F but not 150°F. The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft. Detectors shall have a smooth ceiling rating of 2,500 square feet. Detectors shall be located as shown on the drawings and where required by local code authority.
 6. Provide fixed temperature 190°F detector in kitchen and kiln room in lieu of combination rate-of-rise / fixed-temperature type.
- M. Auxiliary AHU Relays: Air Products model MR-101C relays shall be provided for HVAC and AHU control and interface. Relays shall be heavy-duty type with contacts rated up to 10 amps at 120V AC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with DPDT contacts as well as activated LED indicator.
- N. Voltage sensing relays: Addressable control modules for voltage sensing relay interface shall be FCM-1.
- O. Monitor Module:
1. Addressable monitor modules shall be provided where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices to an intelligent SLC loop.
 2. The monitor module shall provide address setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the monitor

module is operational and in regular communication with the control panel and indicate detection of an alarm condition.

P. Control Module

1. Control/relay modules shall be provided where required to provide audible alarm interface and/or relay control interface. The control module shall be used to connect a supervised zone of conventional indicating devices to an intelligent loop. The zone may be wired class A or class B - field selected. The control module may be optionally wired as dry contact (form C) relay.
2. The control module shall provide address setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the control module is operational and in regular communication with the control panel and indicate when the device is actuated via the fire alarm control panel.

Q. Auxiliary Interface Points: All auxiliary input points (kitchen hoods, water flow, tamper switches, fire extinguishing systems etc.) shall be connected as required, and addressed as a separate initiating point of annunciation at the fire alarm panel and any remote annunciator as required.

R. Water flow switches / Valve supervisory switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor. Wiring of these field devices to the fire alarm system shall be the responsibility of the fire alarm contractor. It is the responsibility of this contractor to ensure the proper function of the system. Each fire protection zone (flow switch) and (Valve switch) shall be addressed electronically and automatically at the control panel as a separate point of annunciation at the fire alarm panel. Coordinate exact location with fire protection contractor and civil drawings.

S. Beam detectors:

1. Microprocessor based beam detectors, consisting of a separate transmitter and matching receiver.
2. Coverage up to 350 ft. X 60 ft.
3. LED status indicators for normal (green), alarm (red), and trouble (yellow).
4. The detectors shall provide address setting means electronically and automatically at the control panel.

2.7 MAGNETIC DOOR HOLDERS, AUTOMATIC FIRE DOORS / SHUTTERS, AND SECURITY GRILLES AND INTERIOR SPACE CONTROLLED ACCESS EGRESS DOORS WITH AUTOMATIC EMERGENCY EGRESS ELECTRIC LOCK EMERGENCY RELEASE

A. Magnetic fire door hold open devices, interface for automatic roll down fire doors/shutters, and interface for security grilles and controlled access egress doors with emergency egress shall be provided. Coordinate with Division 8 and Architectural Drawings for exact location.

B. The operation of any alarm in the fire alarm system shall cause the following:

1. Release of the magnetic fire door holding devices, permitting the fire doors to be closed by the door closer.
2. Permit the automatic roll down fire doors/shutters to close automatically.
3. Permit the security grilles with emergency egress to open automatically.
4. Unlock the electrically controlled access doors in all interior spaces.

- C. The magnetic door holders, automatic roll down fire doors/shutters, security grilles, and interior electrically controlled access doors with emergency egress, shall be associated with two smoke detectors located on the ceiling with one on either side of the fire door/shutter, security grille opening, or interior egress path electrically controlled door. The operation of either of these detectors shall also cause the magnetic holder to release the fire door, the automatic fire door/shutter to close, and the security grille with emergency egress to open.
- D. The operation of smoke detectors associated with a magnetic door holder, automatic roll down fire door, security grille, or electrically controlled access door shall transmit a pre-alarm signal to the fire alarm panel.

2.8 REMOTE PAGING UNIT

- A. Remote all-call paging unit or to activate one of the pre-recorded messages over the speaker circuits.

2.9 REMOTE ALPHANUMERIC DISPLAY ANNUNCIATORS

- A. (Where indicated or required by Local Authority Having Jurisdiction) Remote alpha-numeric annunciator(s) to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator(s) shall be an 80-character display similar to the main FACP and operate via the system RS485 or RS232 serial output terminal from the main FACP. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote annunciator(s) shall include:
 - 1. Integral time/date clock
 - 2. System reset
 - 3. System silence
 - 4. System acknowledge
 - 5. Display/step switch
 - 6. Integral trouble buzzer
 - 7. LCD contrast adjust
 - 8. Fire Drill Operation
- B. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The following primary controls shall be visible through a front access panel:
 - 1. 80 character alphanumeric display, LCD, LED, or gas plasma
 - 2. Individual red system alarm LED
 - 3. Individual yellow supervisory service LED
 - 4. Individual yellow trouble LED
 - 5. Green "POWER ON" LED
 - 6. Alarm acknowledge key
 - 7. Trouble acknowledge key
 - 8. Alarm silence key
 - 9. System reset key
 - 10. LED test

PART 3 - EXECUTION

3.1 EXPANSION OF EXISTING SYSTEM

- A. Testing of existing systems:
 - 1. Provide complete operational test of existing fire alarm system prior to any demolition or construction. Verify operation of each device, control panel, distribution equipment and associated accessories.
 - 2. Provide a complete written report to the Architect, indicating any deficiencies of the existing system in relation to each component's intended function. In addition, provide deficiencies of the existing system with regard to current Code, ADA, and Local Accessibility Standards requirements. Provide the written report 14 days prior to any work related to the expansion of the existing system.
 - 3. Testing of the existing system shall include all areas and all buildings served by the existing system.
- B. Expand the existing system in all expansion or renovation areas to include requirement specified and as required by the local authority having jurisdiction. Verify compatibility of new equipment with existing system.
- C. Provide smoke detectors in the following locations in addition or renovated areas:
 - 1. All paths of egress and adjoining spaces within the same envelope including but not limited to: corridors, hallways, stairs, lobbies, and elevator landings.
 - 2. At each electrical room, telecommunications/data room, elevator machine room, kiln room, and mechanical room not subject to un-treated or un-filtered outside air.
 - 3. At each storage room and warehouse space.
 - 4. Provide duct smoke detectors in all air handling units and outside air units with air volumes of 2,000 cfm or larger.
- D. Provide heat/thermal detectors in the following locations in addition or renovated areas:
 - 1. At each mechanical room subject to un-treated or un-filtered outside air.
 - 2. At each janitor's closets.
- E. Provide manual pull stations in addition or renovated areas at each exterior exit and at each exit from all floors.
- F. Provide weatherproof exterior audio/visual alarm devices mounted on the building at the following locations:
 - 1. Main entry.
- G. Provide beam type detectors at the following locations when appropriate:
 - 1. High ceiling corridors where maintenance of spot type detectors may be difficult.
 - 2. Areas with skylights.

3.2 GENERAL REQUIREMENTS

- A. Installation shall include the delivery, storage, setting in place, fastening to the building structure, interconnection of the system components, alignment, adjustment and all other work, whether or not expressly specified, which is necessary to result in a tested and operational system.
- B. All installation practices shall be in accordance with, but not limited to, the specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements and recommendations of the National Electrical Code and any authorities having jurisdiction. Proper protection against corrosion shall be provided on all electrical equipment in accordance with the requirements of the National Electrical Code. The installation shall conform to all manufacturers' recommendations.
- C. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and support shall be adequate to support their loads with a safety factor of at least three.
- D. All boxes, equipment, etc., shall be plumb and square. The contractor must take such precautions as are necessary to prevent and guard against electrostatic hum, to supply adequate ventilation, and to install the equipment to provide reasonable safety for the operator.
- E. In the installation of equipment and cables, coordinate with Architectural drawings for possible conflicts with millwork, casework, marker boards, furniture, lockers, etc., and notify the architect of any discrepancies. Verify modifications before proceeding with installation.
- F. Mount end-of-line resistor for each box circuit in backbox located at the last manual alarm station or automatic initiating device in a circuit. Mark device accordingly in the field.
- G. Contractor shall submit on completion of system verification, a point-by-point check list 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 prior to date of substantial completion.
- H. Provide remote alphanumeric display annunciators as required by the Local Authority Having Jurisdiction and/or where indicated on the drawings.
- I. Provide remote paging units adjacent to each remote alphanumeric display communicator for voice alarm system.
- J. Alarm devices shall be ceiling mounted unless indicated specifically otherwise. Alarm devices in Mechanical, Electrical, Communications, and IDF / MDF Rooms shall be wall mounted and coordinated with other equipment, piping and ductwork.
- K. Detectors shall be installed per NFPA 90A and be listed with the fire alarm control panel.
- L. Power for magnetic door holders should be provided from the nearest receptacle circuit wired through fire alarm relay.
- M. Smoke detectors shall be mounted to a 4-inch octagon box with hanger bar or with box secured to building structure.

- N. Provide power via 120-volt, 20-Amp dedicated circuits with lock-on provisions at the respective circuit breaker for each new main fire alarm control panel, each new panel extender and each new remote power supply at no additional cost to the Owner. The complete fire alarm system shall be powered under emergency power when emergency life safety power is available at the project site. When emergency life safety power is not available at the project site, power shall originate from the nearest available 120-volt panel, or as indicated.

3.3 CABLE AND BOXES INSTALLATION

- A. All circuits shall be protected to avoid interruption of service due to short-circuiting or other conditions, which might adversely affect the connected devices. Each individual signaling circuit shall be classified as a circuit pair.
- B. All cabling in racks, cabinets and junction boxes shall be neatly strapped, dressed and adequately supported. Cable installation shall conform to good engineering practices and to the standards of the National Electrical Code.
- C. Cables shall be terminated with the proper connector required for the associated operation of the equipment to which it is connected. Screw terminal blocks shall be furnished for all cables, which interface with racks, cabinets, consoles or equipment modules.
- D. All cables within a rack, console or junction box shall be grouped according to the signals being carried to reduce signal contamination.
- E. Where shielded conductors enter a panel or enclosure, and where power wiring exists, provision shall be made to provide physical isolation of signal and power conductors.
- F. Supply and install all fittings and accessories whether or not they are specified, required for proper, safe and reliable operation of the system.
- G. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit fill shall not exceed 40%.
- H. Minimum conduit size shall be 3/4" EMT with insulated bushings. Install conduit per engineered shop drawings.
- I. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed to view and or subject to damage.
- J. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- K. All junction boxes containing fire alarm wiring are to be painted red.
- L. All plenum wiring is to be installed parallel and perpendicular to the building structure. Cable shall be bundled with cable ties on a maximum of 2'-6". Install cables in D-ring hangers secured to the

structure at a maximum of 5' on center. Cable shall not lie on ceiling grid or ceiling tiles, light fixtures, piping, ductwork or foreign equipment.

- M. The system ground is to be connected to the local ground bus. Under no conditions shall the AC neutral either in a power panel or in receptacle outlets be used for a reference ground.
- N. All wiring shall be in accordance with NFPA 72, the National Electrical Code, and Local Codes. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- O. All wire shall be UL Listed FPL for limited energy (300V) and fire alarm applications and shall be installed in conduit. Limited energy FPLP or MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 and approved by the local authority having jurisdiction.
- P. No other wiring shall be run in the same conduit as fire alarm wiring.
- Q. All fire alarm wiring to be red. All fire alarm circuits shall be identified at each termination and at each 25 feet between terminations.
- R. Copper wiring leaving or entering main building shall be protected on both ends with surge suppression; otherwise use fiber-optic cabling.

3.4 ALARM SYSTEM SEQUENCE OF OPERATION

- A. General:
 - 1. All fire alarm circuits shall be electrically supervised.
 - 2. Automatic response functions shall be accomplished by the first device initiated. Alarm functions resulting from initiation by the first device shall not be altered by subsequent alarms. An alarm signal shall be the highest priority. A pre-alarm signal shall have second priority and supervisory or trouble signals shall have third and fourth level priority. Signals of a higher level priority shall take precedence over signals of lower priority even though the lower priority condition occurred first.
- B. Fire alarm operating sequences shall be as follows:
 - 1. Activation of any automatic detector, manual station, or sprinkler flow switch shall cause the location of alarm to be identified in an audible and visual manner at the building fire alarm control panel (FACP), and shall initiate the following events:
 - a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LED to a steady state.
 - b. The 80-character display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises.
 - c. Any remote or local annunciator LED's associated with the alarm point shall be illuminated as herein specified.

- d. The remote signaling connection shall be activated relaying the alarm signal to an approved central station (central station connection and service provided by Owner). Point ID and descriptor must be sent and received.
 - e. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.
 - f. Activate all audible/visual alarm devices. Where prerecorded voice announcement is required or specified, the prerecorded announcement shall be preceded with attention tone(s), followed by the approved prerecorded announcement and continue in a cycle until the system is reset. Manual voice announcement shall interrupt the prerecorded cycle and the prerecorded cycle shall resume automatically after three minutes.
 - g. De-activate all HVAC systems.
 - h. De-energize the kitchen hood supply/exhaust fans as required by local authority having jurisdiction.
 - i. Close all related smoke/fire dampers.
 - j. Release all magnetic door hold open devices.
 - k. Open all security grilles with emergency egress.
 - l. Activate to close all related fire and smoke doors and shutters.
 - m. Activate signaling connection to the elevator as required by the local authority having jurisdiction.
 - n. Signal the building automation system and security system, and Owner's security/police personnel as directed by Owner/Architect. The audible alarms shall be inhibited from being silenced for a period of 3 minutes after commencing operation unless alarm is acknowledged and appropriate action has been taken.
 - o. Release the electric strike, unlocking, but not unlatching, locked doors controlled by an access control system. Release Counter Shutters and hold-open devices on all fire and smoke doors.
 - p. Activate automatic recall operation of elevators as required by local authority having jurisdiction.
2. Activation of duct mounted smoke detector on the HVAC equipment, or a smoke detector mounted in the return/supply air stream of any fan shall shut down all units as required by NFPA. The activation of one of these detectors shall initiate the Alarm Sequence of Operation.
 3. Activation of a control valve supervisory switch shall initiate the following events:
 - a. The activation of any sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the building fire alarm control panel (FACP). Differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring shall be provided.
 - b. Activation of a sprinkler system control valve supervisory switch shall not prevent the events listed under Article 3.4.
 - c. Restoring the valve to the normal position shall cause the supervisory service audible signal to pulse, indicating the restoration to normal position. The supervisory service reset key shall be provided to silence the audible signal.
 4. Activation of the smoke detector and heat detector in the elevator machine room and at top of elevator shaft shall cause the elevators' controllers to be tripped by way of the shut trip breaker, and shall also initiate the events listed under Article 3.4.
 5. Any subsequent fire alarm shall reactivate the alarm indicating appliances and activate the respective control sequences described above.
 6. Upon reset of the fire alarm control panel, HVAC units shall be capable of being started, and resume normal operation.

- C. Activation of the manual evacuation pull station shall operate the alarm indicating appliances without causing other control circuits to be activated. However, should true alarm occur, all alarm functions should occur as described.
- D. ALARM VERIFICATION shall be field programmed for each respective detector. Global verification will not be acceptable. The verification sequence is activated after a "check" procedure and the panel will wait a field programmable delay period (0-50 seconds) then proceed to re-sample the detector for continued presence of smoke. If the alarm condition still exists or a non-verified device is actuated during the verification period, the system will then initiate all alarm sequences specified herein. The system shall incorporate the ability to log in memory the number of verification events that have occurred for each selected device.

3.5 EQUIPMENT IDENTIFICATION

- A. Each new panel or equipment enclosure shall be provided with a permanently engraved or embossed or silkscreen identification tag. The tag shall include the following information:
 - 1. Name of manufacturer.
 - 2. Manufacturer's equipment description.
 - 3. Serial number and model number.
 - 4. Voltage and current rating.

3.6 SPARE PARTS AND TOOLS

- A. Interchangeable Parts: All spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the site in unopened cartons for storage as directed by the Owner.
- B. Spare Parts: Provide minimum of one, or 5% of renovation area total, whichever is greater unless noted otherwise.
 - 1. Spare shut down modules
 - 2. Spare detectors of each type in the system
 - 3. Spare alarm indicating devices of each type in the system
 - 4. Spare manual pull stations
 - 5. Spare protective covers of each type in the system.
 - 6. Devices listed above are to be installed as directed by Architect/Engineer or local code authorities at no additional cost to the Owner. Unused spare parts are to be parts for Owner's cabinet.
 - 7. Provide one telescopic pole for each type of area detector located above 12 feet AFF to facilitate removal and installation of detector head.
- C. Parts list: Furnish a list, in duplicate, of all other parts and accessories the manufacturer of the system recommends to be stocked for maintenance.

3.7 KEYS

- A. Keys and locks for all equipment shall be identical to the existing building master key for the fire alarm system.

3.8 GRAPHIC FLOOR PLANS

- A. Provide updated color coded floor plan detailed with actual room names, actual graphic room numbers as directed by the Owner and adequate information to direct people to the fire alarm devices in alarm and to exits with non-fading floor plan media. Do not use architectural plan room names and numbers.
- B. Each plan shall clearly relate the room numbers on the annunciator to the area description on the floor plan. All fire alarm devices located to correspond with the annunciator.
- C. The floor plan shall be solvent welded in acrylic plastic.
 - 1. Mount in an extruded aluminum frame next to the main fire alarm control panel.
- D. Install graphic floor plans as directed by Architect/Owner prior to substantial completion. Each area or room designation shall be verified with the fire alarm device during testing.

3.9 ADDITIONAL REQUIREMENTS

- A. Coordinate with Owner for appropriate off-site monitoring service and communication technology to be used. Provide all necessary programming for interfacing with the Owner's on-site and off-site remote signaling receiving station, including programming of descriptors and addresses at the receiving station.
- B. The contractor is to ensure all areas of the renovation and new construction are covered with visual and audio alarm devices for occupant notification of a fire alarm including remote portable or temporary buildings.
- C. Coordinate door hold devices with door and door hardware.
- D. Provide interface with and coordinate shunt-trip circuit breakers and control devices with kitchen hood fire control systems (where new kitchen hood fire control systems are provided) and elevator equipment (where new elevators are provided).
- E. Alarm circuit power supplies and circuiting shall be designed and installed to accept an additional five (2) 110cd visual devices for future expansion. The initial design shall not exceed 70% of the rated power supply and circuit capability with the two additional 110cd devices installed.
- F. Provide programming or re-programming of all hot keys as directed by Owner including, but not limited to, fire drill, AHU shutdown bypass, horn/strobe disable, elevator test.

3.10 COMMISSIONING THE SYSTEM

- A. The installing contractor shall be responsible for verifying that each new or relocated component of the system is fully operational and in conformity with the specifications. He shall also be responsible for insuring that all elements function together as a system in accordance with the specifications.
- B. A state licensed and factory trained technical representative of the manufacturer with NICET Level 3 minimum certification shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
- C. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. Any new or relocated items located within the construction or renovation area found not properly installed or non-functioning shall be replaced or repaired and retested. The final test indicating a fully functional fire alarm system shall be recorded; electronic Excel and printed copy submitted to the Architect, Engineer and Owner.
- D. The installing contractor shall provide a complete digital report of the functional test of the entire system after all existing deficiencies of the existing system have been corrected by the Owner, or as directed by the Owner. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout. This test shall be completed and accepted by the Owner prior to testing for the local Fire Marshall.
- E. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections, as may be required by the local authorities. The Contractor shall affix his certification label and installation certificate to the interior of the main fire alarm control panel.
- F. The testing and acceptance shall be performed within 30 days after the fire alarm installation is completed. The test shall be performed by a minimum of two qualified fire alarm system technicians acceptable to the authority having jurisdiction. The test which is a comprehensive 100 percent inspection and test of all fire alarm system equipment shall include the following:
 - 1. Fire alarm control equipment: a visual and functional test of the fire alarm control and auxiliary control equipment.
 - 2. A visual inspection shall be conducted to establish that all electrical connections and equipment, as required, are properly installed and operating.
 - 3. A functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that wiring is properly supervised as required.
 - 4. Indicators shall be tested to ensure proper function and operation.
 - 5. Control panel auxiliary functions shall be functionally tested to verify proper operation.
 - 6. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. A three-minute general alarm stress test, both under AC power and standby power, shall be conducted to further ensure complete operation of the system.
 - 7. Fire alarm peripheral devices; All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
 - 8. Manual initiating devices:
 - a. Each manual fire alarm station shall be functionally tested for alarm operation.

- b. Each manual fire alarm station shall be functionally tested for proper wiring supervision.
 - 9. Automatic initiating devices:
 - a. Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
 - b. Each automatic initiating device shall be inspected to ensure proper placement and mounting as required by specifications.
 - 10. Alarm signaling devices:
 - a. Each alarm signaling device shall be tested and decibel reading taken at 10' from the device and recorded to ensure proper operation. Each area's voice alarm signaling devices shall be tested for intelligibility.
 - b. Each alarm signaling device shall be functionally tested for proper wiring supervision.
 - c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility.
 - d. All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
 - 11. Elevators: Each elevator shall be tested and automatic recall function verified.
 - 12. Reporting: Upon completion of the initial verification audit, a report shall be sent to the Architect/Engineer indicating that all fire alarm equipment has been tested and is in 100 percent operation. The report shall also contain the audit testing information as to the location and operational status of each peripheral device. The 100 percent audit shall be performed by a factory-trained representative. The report shall include the voice intelligibility performance in each area and indicate compliance with NFPA and local AHJ requirements.
- G. It is the intent of these specifications and of the Architect/Engineer that a continued program of system maintenance will be provided by the Owner in compliance with NFPA 72. It is mandatory that the installing Contractor provide such services and make available these services to the Owner upon completion of the project.
- H. Upon completion of installation and full acceptance testing, submit NFPA 72 certificate of compliance that the total fire alarm system, including any subsystems, is fully functional and that the components are UL listed for function intended.
- 3.11 SUBSTANTIAL COMPLETION
- A. Final acceptance of the FIRE ALARM SYSTEM by the owner, local code authorities and Occupancy Permit has been issued.
 - B. All fire alarm system shop drawings, operating and maintenance manuals, maps and as-built drawings shall be submitted to and accepted by the Architect / Owner prior to date of substantial completion.
- 3.12 WARRANTY
- A. All new fire alarm devices, new panels, new equipment and new accessories, including labor and material, shall be free from defects in workmanship and materials, under normal use and service,

for a period of one year from the date of substantial completion. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner within 4-hour notification.

- B. Repair services and replacement parts for the system to be furnished under this Contract shall be available for a period of ten years after the date of final acceptance. Service during the warranty period shall be provided within four hours after notification and all repairs shall be corrected within 24 hours after notification throughout the warranty specified in this section.
- C. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- D. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.
- E. Provide a certified fire alarm test of the complete system at the end of the warranty period and correct any and all items located in the area of renovation to bring the system to an approved status at no cost to the Owner. Clean all smoke detectors and replace all defective parts within the area of renovation at no cost to the Owner.
- F. Guarantee labor, materials, and equipment provided under this contract against all defects for a period of one year after the date of final acceptance and receipt and approval of “As-Built” drawings and schematics of all equipment.

END OF SECTION

SECTION 321813 - SYNTHETIC GRASS SURFACING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Synthetic grass surfacing.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Synthetic grass surfacing.
- B. Shop Drawings: For synthetic grass surfacing.
 - 1. Include sections and details.
 - 2. Show locations of seams and method of seaming.
 - 3. Show layout of game lines, numbers, and letters. Indicate application method of each line and marking.
 - 4. Show location and layout of team logo/graphics.
- C. Samples: For each type of synthetic grass surfacing indicated.
 - 1. Turf Fabric: 12 inches square.
 - 2. Game Line Turf Fabric: 12 inches long by actual width.
 - 3. Shock-Attenuation Pad: 12 inches square.
 - 4. Seam Sample: 24 inches square with seam centered in sample.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each synthetic grass surfacing assembly.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For synthetic grass surfacing, including maintenance cleaning instructions, to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Turf Fabric: Minimum of 300 sq. ft. for each type indicated.
 - 2. Infill: Minimum of two bags of each type.
 - 3. Seaming Tape and Adhesive: One roll of seaming tape and one gallon of adhesive.
 - 4. One new set of maintenance tools, of type recommended by synthetic grass surfacing manufacturer for installation.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in location and manner to allow installation of synthetic grass surfacing without excess disturbance of granular base.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration and excessive wear.
 - b. Deterioration from UV light.
 - c. Excessive loss of shock attenuation.
 - d. Seam separation, including game lines and markings.
 - 2. Warranty Period: 8 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Turf Fabric: Turf fabric tested in accordance with the following methods, with additional test method conditions for each method in accordance with ASTM F1551.
 - 1. Tuft Bind: Not less than 8 lbf in accordance with ASTM D1335.
 - 2. Breaking Strength: Minimum 200 lbf in warp direction and minimum 200 lbf perpendicular to warp direction, in accordance with ASTM D5034.

2.2 SYNTHETIC GRASS SURFACING

- A. Synthetic Grass Surfacing for Field Sports: Complete surfacing system, consisting of synthetic yarns bound to water-permeable backing and infill indicated, suitable for multipurpose sport playing fields.
 - 1. Tarkett Sports Dropturf
 - 2. GrassTex Vmax
 - 3. RFS Sports Impact 40
- B. Turf Fabric: Woven turf fabric with multicolored fiber and UV resistance, complying with the following:
 - 1. Yarn Fiber: Slit-film polyethylene.
 - 2. Lead Content of Yarn Fiber: Maximum of 100 ppm in accordance with ASTM F2765.
 - 3. Pile Weight: 40 oz. / yd² in accordance with ASTM D5848.
 - 4. Pile Height: 0.75 inches in accordance with ASTM D5823.
- C. Backing: Manufacturer's standard woven or nonwoven polypropylene primary backing with urethane-coated secondary backing; provide perforations or drainage channels sufficient to meet permeability indicated.
- D. Infill: Manufacturer's standard to not require infill.
 - 1. Infill Proportions: Manufacturer's standard proportions.
- E. Game Lines and Markings: Provide game lines and markers in widths and colors in accordance with requirements indicated on Drawings.
 - 1. Application Method: Tufted in to the maximum extent practicable, with remaining lines inlaid.
 - 2. Team Logo/Graphic: Provide inlaid team logo/graphic in colors and design indicated.
- F. Seaming Method: Adhesive.

2.3 MATERIALS

- A. Seam Adhesive: One- or two-part urethane, recommended or approved by synthetic grass surfacing manufacturer, and suitable for ambient conditions at time of installation.
- B. Seam Tape: Synthetic grass manufacturer's recommended seam tape, minimum 12 inches wide, 18 inches wide for inlaid game lines.
- C. Seaming Cord: Seaming cord or thread, recommended by the synthetic grass surfacing manufacturer.
- D. Game Line Paint: Permanent paint as recommended or approved by synthetic grass surfacing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine base and other conditions, with Installer present, for compliance with requirements for installation tolerances, permeability, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SYNTHETIC GRASS SURFACING

- A. Avoid disturbance of base during installation of shock-attenuation pad and turf fabric.
- B. Shock-Attenuation Pad Installation: Roll out pad and allow to relax a minimum of six hours prior to final fit and trim. Stagger head seams between adjacent rows. Fit seams snugly without stretching or forcing.
- C. Roll out turf fabric and allow to relax at least four hours prior to seaming.
- D. Provide seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Attach turf fabric to perimeter restraint system as recommended by the manufacturer.
- E. Install inlaid game lines and markings by cutting through turf fabric and installing snugly fitting game line turf fabric. Provide seaming tape that extends minimum 6 inches beyond seam.
- F. Repair loose seams and bubbles formed due to expansion of turf fabric prior to installation of infill.
- G. Evenly broadcast and groom infill by machine in proportions and depth after settling as recommended by the manufacturer, and to meet indicated performance requirements. Rake fibers trapped by infill to surface.
- H. Painted Game Lines: Apply lines and markings as recommended by the game line paint manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel in proper maintenance procedures for synthetic grass surfacing.

END OF SECTION