

PROJECT MANUAL



TULSA PERFORMING ARTS CENTER



**TULSA PERFORMING ARTS CENTER
PACKAGE NO. 1 AND NO. 2**

**Owner Project No. SP 23-2
Beck Project No. 202304**

January 24, 2024



**SECTION 00 01 01
PROJECT TITLE PAGE**

PROJECT MANUAL

FOR

TULSA PERFORMING ARTS CENTER

ARCHITECT'S PROJECT NUMBER: 202331.00.

OWNER'S PROJECT NUMBER: SP 23-2.

OWNER

TULSA PERFORMANCE ART CENTER

110 E. 2ND STREET

TULSA, OKLAHOMA 74103

DATE: JANUARY 24, 2024

PREPARED BY:

BECK DESIGN

END OF SECTION

**SECTION 00 01 02
PROJECT INFORMATION**

PART 1 GENERAL

1.01 PROJECT IDENTIFICATION

- A. Project Name: Tulsa Performing Arts Center, located at:
- B. Architect's Project Number: 202331.00.
- C. Owner's Project Number: SP 23-2.
110 E. 2nd Street.
Tulsa, Oklahoma74103.
- D. The Owner, hereinafter referred to as Owner: Tulsa Performance Art Center

1.02 PROCUREMENT TIMETABLE

- A. The Owner reserves the right to change the schedule or terminate the entire procurement process at any time.

1.03 PROCUREMENT DOCUMENTS

- A. Availability of Documents: Complete sets of procurement documents may be obtained:
 - 1. From Lowry Construction Services, Inc. at the Project Manager's email address:
hutton@lowrycs.com

1.04 BID SECURITY

- A. Bids shall be accompanied by a security deposit as follows:
 - 1. Security made payable to Owner in an amount of five percent of proposer's maximum proposal price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 00 01 03
PROJECT DIRECTORY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Identification of project team members and their contact information.

1.02 OWNER:

- A. Name: Tulsa Performance Art Center
 - 1. Address: 110 E. 2nd Street.
 - 2. City: Tulsa.
 - 3. State: Oklahoma.
 - 4. Zip Code: 74103.
 - 5. Telephone: 918.596.7111.
- B. Primary Contact: All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
 - 1. Title: Design Partner.
 - 2. Name: Wesley Rutledge.
 - 3. Email: WRutledge@beckdesign.com.

1.03 CONSULTANTS:

- A. Architect: Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
 - 1. Company Name: Beck Design.
 - a. Address Line 1: 110 West 7th Street, Suite 710.
 - b. City: Tulsa.
 - c. State: Oklahoma.
 - d. Zip Code: 74119.
 - e. Telephone: 918.583.5300.
 - 2. Primary Contact:
 - a. Title: Design Partner.
 - b. Name: Wesley Rutledge.
 - c. Email: WRutledge@beckdesign.com.
- B. Mechanical, Electrical, and Plumbing Engineering Consultant:
 - 1. Company Name: Phillips + Gomez.
 - a. Address Line 1: 15 W. 6th St, Suite 2510.
 - b. City: Tulsa.
 - c. State: Oklahoma.
 - d. Zip Code: 74119.
 - e. Telephone: 918.584.0102.
- C. Audiovisual Systems Consultant:
 - 1. Company Name: Schuler Shook.
 - a. Address Line 1: 219 Main Street SE, Suite 200.
 - b. City: Minneapolis.
 - c. State: Minnesota.
 - d. Zip Code: 55414.
 - e. Telephone: 612.339.5958.

1.04 CONSTRUCTION MANAGER:

- A. Company Name: Lowry Construction Services, Inc..
 - 1. Address Line 1: 1729 S Boston Ave.
 - 2. City: Tulsa.
 - 3. State: Oklahoma.

4. Zip Code: 74119.
5. Telephone: 918.592.2442.

B. Primary Contact:

1. Name: Hutton Lowry.
2. Email: hutton@lowrycs.com.
3. Phone: 918.640.1863

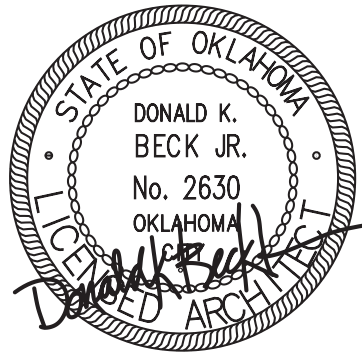
PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 00 01 07
SEALS PAGE**

**ARCHITECT
BECK DESIGN
131 DEAN A MCGEE, SUITE 135
OKLAHOMA CITY, OK 73102**



END OF SECTION

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END OF SECTION



TOBACCO FREE AFFIDAVIT

Bidder must sign an Affidavit as follows:

AFFIDAVIT AND DECLARATION OF BIDDER

STATE OF _____

COUNTY OF _____

Affiant _____, being first sworn upon oath, state:

1. That I am the _____ of _____
(title) (company)
(hereinafter known as "Bidder")

2. I declare that no employee working on the premises under the authority of the Bidder will be permitted to use tobacco products in Owner facilities and on Owner property. The Bidder and its sub-contractors and suppliers, their agents or employees, and any other persons performing any work on behalf of the Bidder, will not use tobacco products on Owner property.

3. The Bidder agrees to prominently display a Notice stating that Owner property is a tobacco-free site.

FURTHER AFFIANT SAYETH NOT.

DATED this _____ day of _____, 20____

Bidder or Authorized Agent

Subscribed and sworn to before me this _____ day of _____ 20____

My Commission Expires: _____

Notary Public

DRUG-FREE AFFIDAVIT

STATE OF _____

COUNTY OF _____

I, _____, of lawful age, being first duly sworn, on oath says that _____ is the agent authorized by Contractor to submit the attached Drug- Free Affidavit to the Owner as stated below, and the County as stated below, in the State of Oklahoma. Affiant further states the following:

- 1. No employee working on premises under the authority of the contractor will be permitted to use a controlled substance at any time. The Contractor, sub-contractors and suppliers, their agents or employees and any other persons performing any work on behalf of the Contractor, will not be permitted to use a controlled substance at any time.
- 2. Contractor agrees to prominently display a Notice stating that school property is a drug- free site and that all persons entering school property are subject to random drug testing.
- 3. Contractor agrees to publish a statement notifying Contractor employees, sub-contractors and suppliers and their agents or employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor’s workplace and specifying the actions that will be taken against employees for violations of such prohibition. Contractor agrees to provide all employees engaged in performance of the contract with a copy of the statement.

Project Name: _____ in the

District Number: _____ in the

County of _____ in the

State of Oklahoma.

Signature

Subscribed and sworn to before this _____ day of _____ 20____.

My Commission Expires: _____

Notary Public

NON-KICKBACK STATEMENT AFFIDAVIT

STATE OF _____

COUNTY OF _____

The undersigned _____, of lawful age, being first duly sworn, on oath states: that this invoice or claim is true and correct; the work, services, or materials as shown by this invoice or claim have been completed or supplied in accordance with the plans, specifications, orders or requests furnished the claimant: that claimant has made no payment directly or indirectly to any elected official, officer, or employee of the Owner, of money or other thing of value to obtain payment of the invoice or procure the contract or purchase order pursuant to which an invoice is required.

Affiant

Subscribed and sworn to before me this _____ day of _____ 20 _____

My Commission Expires: _____

Notary Public

END OF SECTION

(THIS AFFIDAVIT IS TO ACCOMPANY THE BID)

BUSINESS RELATIONSHIPS AFFIDAVIT

STATE OF _____

COUNTY OF _____

_____,
of lawful age, being first duly sworn, on oath says that (s)he is the agent authorized by the bidder to submit the attached bid. Affiant further states that the nature of any partnership, joint venture, or other business relationship presently in effect or which existed within one (1) year prior to the date of this statement with the architect, engineer, or other party to the project is as follows:

Affiant further states that any such business relationship presently in effect or which existed within one (1) year prior to the date of this statement between any officer or director of the bidding company and any officer or director of the architectural or engineering firm or other party to the project is as follows:

Affiant further states that the names of all persons having any such business relationships and the positions they hold with their respective companies or firms are as follows:

(If none of the business relationships herein above mentioned exist, affiant should so state.)

Affiant

Subscribed and sworn to before me this _____ day of _____ 20 _____

My Commission Expires: _____

Notary Public

SUBSTITUTION REQUEST

(DURING THE BIDDING/NEGOTIATING PHASE)

Project: _____ Substitution Request Number: _____

 From: _____
 To: _____ Date: _____

 A/E Project Number: _____
 Re: _____ Contract For: _____

Specification Title: _____ Description: _____
 Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
 Manufacturer: _____ Address: _____ Phone: _____
 Trade Name: _____ Model No.: _____
 Installer: _____ Address: _____ Phone: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified product: _____

Point-by-point comparative data attached — **REQUIRED BY A/E**

	SPECIFIED PRODUCT	SUBSTITUTION	
NAME, BRAND			
CATALOG NUMBER			
MANUFACTURER			
VENDOR			
SIGNIFICANT VARIATIONS (PROVIDE ON ADDITIONAL SHEETS AS NECESSARY TO DESCRIBE)			
MAINTENANCE SERVICE AVAILABLE?		YES	NO
SPARE PARTS SOURCE		YES	NO
WARRANTY PROVIDED			
WARRANTY DURATION	_____ years	_____ years	
WARRANTY BY WHOM			

SUBSTITUTION REQUEST

(DURING THE BIDDING/NEGOTIATING PHASE)

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).

Proposed substitution changes Contract Time: No Yes [Add] _____ [Deduct] _____

_____ days.

Supporting Data Attached: Drawings Product Data Samples Tests Reports _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

SUBSTITUTION REQUEST

(DURING THE BIDDING/NEGOTIATING PHASE)

A/E's REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures. Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by:

Date:

Supporting Data Attached: Drawings Product Data Samples Tests Reports _____

FORMS THAT ARE NOT FULLY FILLED OUT OR FORMS THAT HAVE NOT BEEN SIGNED WILL BE RETURNED UNOPENED.

(THIS AFFIDAVIT IS TO ACCOMPANY THE BID)

NON-COLLUSION AFFIDAVIT

STATE OF _____

COUNTY OF _____

_____, of lawful age, being first duly sworn, on oath says that (s)he is the agent authorized by the bidder to submit the attached bid. Affiant further states that the bidder has not been a party to any collusion among bidders in restraint of freedom of competition by agreement to bid at a fixed price or to refrain from bidding; or with any state official or employee as to quantity, quality, or price in the prospective contract, or any other terms of said prospective contract; or in any discussions between bidders and any state official concerning exchange of money or other thing of value for special consideration in the letting of a contract.

Affiant

Subscribed and sworn to before me this _____ day of _____ 20 ____

My Commission Expires: _____

Notary Public

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned (1) _____
as Principal, and (2) _____,
as Surety, are hereby held and firmly bound unto (3) _____
_____ as Owner, in
the penal sum of (4) _____ for the
payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs,
executors, administrators, successors and assigns.

Signed this _____ day of _____, 20 _____

The condition of the above obligation is such that whereas the Principal has submitted to
(3) _____
a certain Bid, attached hereto and hereby made a part hereof into a Contract in writing, for the
(5) _____

NOW, THEREFORE,

- (1) If said Bid shall be rejected, or in the alternate,
- (2) If said Bid shall be accepted and the Principal shall execute and deliver a Contract in the Form of Contract attached hereto (properly completed and in accordance with said Bid) and shall furnish a bond for this faithful performance of said Contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims here under shell, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates, and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by an extension of the time within which the Owner may accept such bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their proper officers, the day and year first set forth above.

(Seal)

Principal

(L.S.)

Surety

- (1) Name of Contractor
- (2) Name of Surety
- (3) Corporate name of Owner
- (4) 5% Bid Amount
- (5) Clear, Concise Description

By _____

DOCUMENT 00 52 00

STATUTORY BOND

KNOW ALL MEN BY THESE PRESENTS:

That (1) _____ Principal, and
Contractor

(2) _____
Name of Surety

and (3) _____
Corporation, partnership or Individual

organized under the laws of the State of _____ and

authorized to transact business in the State of Oklahoma, as Surety, and held and firmly bound unto

(4) _____ in the penal sum of
Owner

_____ Dollars \$ _____

in lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves and each of us, our heirs, executors, administrators, trustees, successors, and assigns, jointly and severally, firmly by these presents.

DATED this _____ day of _____, 20 _____

The condition of this obligation is such that:

WHEREAS, said Principal entered into a written Contract with

(4) _____, dated
Owner

_____, 20 _____,

for (5) _____ all in compliance
Description of Work

with the Drawings and Specifications therefore, made a part of said Contract and on file in the office of

(6) _____
Name and Address of Owner

NOW, THEREFORE, if said Principal shall fail or neglect to pay all indebtedness incurred by said Principal or Subcontractors of said Principal who perform work in the performance of such Contract, for labor and materials and repairs to and parts for equipment used and consumed in the performance of said Contract within thirty (30) days after the same becomes due and payable, the person, firm or corporation entitled thereto may sue and recover this Bond, the amount so due and unpaid.

It is further expressly agreed and understood by the parties hereto that no changes or alterations in said Contract and no deviations from the plan or mode of procedure herein fixed shall have the effect of releasing the Sureties, or any of them, from the obligations of this Bond.

It is further and expressly agreed and understood by the parties hereto that no obligation shall exist or be made for notification to said sureties regarding the before- mentioned changes, alterations, deviations, or procedures.

IN WITNESS WHEREOF. the said Principal has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its duly authorized officers, and the said Surety has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by it Attorney-In Fact, duly authorized soto do, the day and year first above written.

ATTEST _____

Principal

Title

Surety

Attorney-In-Fact

- (1) Contractor
- (2) Name of Surety
- (3) Corporation, partnership or Individual
- (4) Owner
- (5) Description of work
- (6) Name and Address of Owner

WARRANTY BOND

KNOW ALL MEN BY THESE PRESENTS:

That (1) _____

Principal, and

(2) _____,

a

(3) _____

organized under the laws of the State of _____ and authorized to transact business in the State of Oklahoma, as Surety, and held and firmly bound unto

(4) _____ in

the penal sum of _____ Dollars (\$ _____) in lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves and each of us, our heirs, executors, administrators, trustees, successors, and assigns, jointly and severally, firmly by these presents.

DATED this _____ day of _____, 20 _____

The condition of this obligation is such that:

WHEREAS, said Principal entered into a written Contract with (4)

_____, dated _____, 20

_____ for (5) _____ all in compliance with the Drawings and Specifications therefore, made a part of said Contract and on file in the office of (6)

NOW, THEREFORE, if said Principal shall pay or cause to be paid to (4) _____

all damage, loss, and expense which may result by reason of defective materials and/or workmanship in connection with said work, occurring within a period of one (1) year from and after acceptance of said project by (4) _____

and if Principal shall pay or cause to be paid all labor and materials, including the prime contractor and all subcontractors; and if Principal shall save and hold (4) _____ harmless from all damages, loss, and expense occasioned by or resulting from any failure whatsoever of said Principal, then this obligation shall be null and void, otherwise to be and remain in full force and effect.

It is further expressly agreed and understood by the parties hereto that no changes or alterations in said Contract and no deviations from the plan or mode of procedure herein fixed shall have the effect of releasing the sureties, or any of them, from the obligations of this Bond.

It is further and expressly agreed and understood by the parties hereto that no obligation shall exist or be made for notification to said sureties regarding the before-mentioned changes, alterations, deviations or procedures.

IN WITNESS WHEREOF, the said Principal has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its duly authorized officers, and the said Surety has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its Attorney-In Fact, duly authorized so

to do, the day and year first above written.

ATTEST

Principal

Title

Surety

- (1) Contractor
- (2) Name of Surety
- (3) Corporation, partnership or Individual
- (4) Owner
- (5) Description of work
- (6) Name and Address of Owner

Attorney-In-Fact

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS.

That:

(1) _____ as Principal, and (2) _____ and
(3) _____

organized under the laws of the State of _____ and authorized to transact
business in the State of Oklahoma, as Surety, and held and firmly bound unto

(4) _____ in the penal sum

of _____ Dollars (\$ _____)

in lawful money of the United States of America, for the payment of which, well and truly to be made, we
bind ourselves and each of us, our heirs, executors, administrators, trustees, successors, and assigns,
jointly and severally, firmly by these presents.

DATED this _____ day of _____, 20 _____

The condition of this obligation is such that:

WHEREAS, said Principal entered into a written Contract with 4) _____

_____, dated _____, 20 _____.

for (5) _____ all in compliance with
the Drawings and Specifications therefore, made a part of said Contract and on file in the office of (4)

(Name and address of Owner)

NOW, THEREFORE, if said Principal shall, in all particulars, well, truly, and faithfully perform and abide
by said Contract and each and every covenant, condition and part thereof and shall fulfill all obligations
resting upon said Principal by the terms of said Contract and said Specifications, and if said Principal
shall promptly pay, or cause to be paid, all labor, materials and/or repairs and all bills for labor performed
on said work, whether by subcontract or otherwise; and if said Principal shall protect and save harmless
said (4) _____

SECTION 00 61 13.13

from all loss, damage and expense to life or property suffered or sustained by any person, firm, or corporation caused by said Principal or his or its agents, or employees in the construction of said work, or by or in consequence of Any negligence, carelessness or misconduct in guarding and protecting the same, or from any act or omission of said Principal or his or its agents, servants, or employees, and if said Principal shall protect and save (4) _____ harmless from all suits and claims of infringement or alleged infringement or patent rights or processes, then this obligation shall be null and void, otherwise to be and remain in full force and effect.

It is further expressly agreed and understood by the parties hereto that no changes or alterations in said Contract and no deviations from the plan or mode of procedure herein fixed shall have the effect of releasing the sureties, or any of them, from the obligations of this Bond.

It is further expressly agreed and understood by the parties hereto that no obligation shall exist or be made for notification to said sureties regarding the before- mentioned changes, alterations, deviations, or procedures.

IN WITNESS WHEREOF, the said Principal has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its duly authorized officers, and the said Surety has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its Attorney-In-Fact, duly authorized so to do, the day and year first above written.

_____ ATTEST

By _____

Surety

Attorney- In- Fact

- (1) Contractor
- (2) Name of Surety
- (3) Corporate, Partnership or Individual
- (4) Owner
- (5) Description of Project

CONTRACTOR'S AFFIDAVIT OF PAYMENT OF DEBTS AND CLAIMS

STATE OF _____

COUNTY OF _____

(1) _____, of lawful age, being first duly sworn, upon his oath, deposes and says: That this is the

(2) _____ of the

(3) _____ a

Corporation/Partnership/Individual organized and existing under the laws of the State of _____

that he makes this Affidavit for and on behalf of said Corporation/Partnership/Individual named herein is the same that entered into an Agreement with the

(5) _____

_____ on the _____ day of _____, 20____, to

(4) _____

_____ day of _____ 20____, to (4) _____

That the said Corporation/Partnership/Individual has completed the work set forth in said Agreement; and that in accordance with said Agreement, Affiant further says under oath that there are no existing claims, judgements or liens, outstanding for labor and/or materials furnished under said Agreement and that all persons, firms or corporations who have performed work or furnished materials under this Agreement have been fully paid. Further affiant sayeth not.

Affiant

Subscribed and sworn to before me this _____ day of _____, 20____.

My Commission Expires: _____

Notary Public

- (1) Affiant
- (2) Office
- (3) General Contractor
- (4) Description of Work
- (5) Owner

CONSENT OF SURETY COMPANY TO FINAL PAYMENT
CERTIFICATE OF APPROVAL

The _____,
 Surety Company, hereby certifies through its constituted Attorney-in-Fact,
 _____, that it has seen the attached
 affidavit of (1) _____ made on behalf of
 (2) _____, a Corporation/
 Partnership/ Individual sworn to on the _____ day of _____, 20_____, stating that
 there was no existing claims, judgments or liens outstanding against said Corporation/
 Partnership/ Individual for labor and/or materials furnished under its Agreement with the (4) _____
 _____ to
 (3) _____ and that all persons, firms or
 corporations who have performed work or furnished materials under said Agreement have been fully paid;
 and furthermore, approved and becomes legally bound to said,
 (4) _____ under the terms of its surety
 Bond Agreement with the Board, by virtue of the execution of said Affidavit without qualification,
 condition, or exception. Further, it consents that the said (4) _____
 shall make its final payment under the above-mentioned Agreement to said corporation upon the showing of
 such affidavit.

Surety Company

 Attorney-in-Fact

Dated this _____ day of _____, 20_____ .

- (1) Affiant
 - (2) General Contractor
 - (3) Description of Work
 - (4) Owner
- (SEAL)

**SECTION 01 10 00
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Tulsa Performing Arts Center

1.02 SECTION INCLUDES

- A. Definitions.
- B. Project delivery method.
- C. Intent of the Contract Documents.
- D. Required Acoustics Seminar by Architect's Acoustics Consultant.
- E. Oklahoma Competitive Bidding Act.
- F. Work covered by Contract Documents.
- G. Common requirements for Fire Suppression, Plumbing, HVAC, Electrical, Communications and Electronic Safety and Security.
- H. Sales tax exempt.
- I. Review of Contract Documents and field conditions by Contractor.
- J. Contractor location of existing underground utilities in area of work and documentation.
- K. Contractor documentation of existing conditions before start of construction.
- L. Damage during construction.
- M. Temporary facilities, utilities and controls.
- N. Work by Owner (Interior Signage).
- O. Contractor use of site and premiss.
- P. Work Sequence.
- Q. Codes and standards.
- R. Permits and inspections by local Authority Having Jurisdiction.
- S. Safety.
- T. Project management and coordination.
- U. Contractor quality control.
- V. Specification format and content.
- W. Drawing format and content.

1.03 DEFINITIONS

- A. Contract for Construction: The Contract Documents form the Contract for Construction.
- B. Contractor: Where the term "Contractor" is used throughout the Contract Documents that term shall mean "Contractor/Constructor" in accordance with Oklahoma State Statute Title 61- Public Buildings and Public Works
- C. Contract Documents: The Contract Documents consist of the Agreement Between Owner and Contractor/Constructor Conditions of the Contract (General and Supplementary Conditions) , Drawings, Specifications, Addenda issued prior to execution of the Contract between Owner and Contractor/Constructor, other documents listed in the Agreement between Owner and Contractor/Constructor and modifications issued after execution of the Contract.
- D. Contracting Requirements: Contracting requirements consist of Contracting forms (agreement) and conditions of the contract (general and supplementary conditions).
- E. Drawings: Drawings are the graphic and pictorial portions of Contract Documents showing design, location and dimensions of the Work, generally including plans, elevations, sections,

details, schedules and diagrams bound together in one or several volumes.

- F. Project Manual: Project manual consists of Bidding Requirements, Contracting Requirements and Specifications bound together in one or several volumes.
- G. Specifications: Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards, workmanship and quality for the Work, and performance of related services.
- H. Work: The term "Work" means the construction and services required by the Contract Documents and includes all other labor, materials, equipment and services provided, or to be provided by Contractor to fulfill the Contractor's obligations to fully complete the Work.

1.04 PROJECT DELIVERY METHOD

- A. Method Type: Public Bid for Construction Manager At Risk.
- B. City of Tulsa Engineering Services requirements.
- C. Contract Modification Procedures and Payment Requirements: Procedures and requirements shall be as directed by Owner and in accordance with Agreement with Owner and Contractor/Constructor.
- D. Execution of Work: Contractor shall fully execute Work indicated in Contract Documents.
- E. Materials, Equipment and Systems: Contractor shall provide all materials, equipment, systems and labor required to fully complete the Work indicated in the Contract Documents without exception.
- F. Affidavits, Bonds and Insurance: Contractor shall provide Affidavits, Bonds and Insurance coverages as required by Oklahoma State Statutes and as required by the Agreement Between Owner and Contractor/Constructor.
- G. Schedule of Submittals: Contractor to submit a Schedule of Submittals to Architect, as specified, within 10 days after Owner issuance of Notice to Proceed.
 - 1. Review entire Project Manual to determine what each Document or Section requires to be submitted.
 - 2. List all items that require submittal for review by Architect and date Contractor anticipates submittal being transmitted to Architect.
 - 3. Indicate type of submittal; product data, shop drawing, sample, certificate, or other submittal.
- H. Applications for Payment: Contractor shall submit applications for payment in accordance with the Agreement between Owner and Contractor.
 - 1. Progress Payments: Upon receipt of application for payment
 - a. Applications shall indicate percentage of completion for each portion of the Work as of the end of the period covered by application.
 - b. Provide all required attachments to document percentage of completion for the Work.
 - 2. Final Payment: Upon receipt of Contractor's written notice that the Work is ready for final inspection, all items on Substantial Completion Punchlist are complete and Contractor has re-inspected the Work, Architect will make final inspection and, when Architect finds the Work acceptable under Contract Documents and Contract fully performed, Architect will promptly issue to Owner a final Certificate for Payment, with a copy to Contractor.
 - a. Substantial Completion and Final Completion procedures specified in Section 01 7700 - Closeout Procedures.
- I. Contractor Warranty: The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects. Work, materials, or equipment not conforming to these requirements shall be considered defective. If required by the Architect, The Contractor shall furnish satisfactory evidence as to the kind of quality of materials and equipment.
 - 1. Contractor's warranty obligation is to correct work within 1 year after Date of Substantial Completion of the Work or designated portion thereof.

2. If, within 1 year after the Date of Substantial Completion of the Work any of the Work is found to be not in accordance with the requirements of the Contract Documents , the Contractor shall correct it promptly after receipt of written notice from the Owner to do so.
3. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with the Agreement between Owner and Contractor/Constructor.

1.05 INTENT OF THE CONTRACT DOCUMENTS

- A. Intent of Contract Documents is to include all items necessary for the proper execution and completion of the Work by Contractor without exception. "All items" include all necessary accessories, appurtenances, fasteners, parts and pieces that may or may not be indicated in the Contract Documents but are necessary for the complete construction of the entire project.
 1. Include as a part of the Work, all miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned in Contract Documents.
 2. Any item, accessory, appurtenance, fastener, blocking, part or piece necessary for the proper execution and complete construction for any item, assembly or system shall be provided as a part of the Work.
 3. Contractor requests for additional sum/price or time not permitted for any and all items necessary for the proper execution and completion of the Work by Contractor whether or not mentioned in Contract Documents.
- B. Contract Documents are complementary and do not have a system of precedence. In the event of conflicts or discrepancies among the separate parts of the Contract Documents, or within any one part of the Contract Documents, and subject to the terms of General Conditions Subparagraph 3.2. "Review of Contract Documents and Field Conditions by Contractor," the Architect shall interpret the conflict or discrepancy based upon the Contract Documents as a whole. Should such a conflict or discrepancy occur, it is the specific intent of the Contract Documents to require the better quality or greater quantity of Work be performed and the Architect's interpretation shall be consistent with this intent.

1.06 OKLAHOMA COMPETITIVE BIDDING ACT

- A. Contractor and all Subcontractors shall comply with all provisions of the "Public Competitive Bidding Act of 1974" contained within Title 61-Public Buildings and Public Works of the Oklahoma State Statutes, as most recently amended.

1.07 WORK COVERED BY CONTRACT DOCUMENTS

- A. Contract Documents are directed to Contractor. Contractor shall fully execute the Work described in Contract Documents, except to extent specifically indicated in Contract Documents to be the responsibility of others.
- B. Provide and pay for all materials, labor, services, equipment, licenses, permits and other items necessary for the execution, installation and completion of work indicated in Contract Documents.

1.08 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

- A. Contractor shall thoroughly and completely field investigate, measure, and verify all existing site conditions and compare with Contract Documents.
- B. All existing conditions and measurements relating to submittals requiring Shop Drawings shall be indicated on Contractor's Shop Drawings and Submittals to Architect for review.
- C. Execution of Contract by Contractor is a representation that Contractor has visited site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.
 1. Prior to submission of Contractor bid, Contractor has a duty, obligation and responsibility to seek clarification of open, obvious or patent error or ambiguity in the proposed Contract Documents.
 2. Contractor has a duty, responsibility and obligation to fully disclose relevant requirements contained in the Agreement Between Owner and Contractor/Constructor and in the

Contract Documents to any entity from which bids or prices are solicited for any portion of the Work, both before and after Bid Date. Requirement shall not be waived for unsolicited bids or prices.

3. During Contractor's careful study and review of Contract Documents and field conditions, Contractor shall note all typographical and spelling errors in the Contract Documents. Any such errors which produce a phrase or sentence in compliance with both well-known technical and trade meanings and common English language usage shall not be deemed a typographical or spelling error. All other such typographical or spelling errors will produce phrases or sentences which are inconsistent with well-known technical and trade meanings or common English usage. Contractor shall report all such errors to Architect.
 4. Field measurements shall include, but shall not be limited to, grades, lines, levels and dimensions. Should Contractor fail to notify Architect of any discovered error, inconsistency or omission, the Contractor's liability shall be as described herein.
- D. Because Contract Documents are complementary, Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as information furnished by the Owner, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at site affecting it. Contractor shall promptly report to Architect any errors, inconsistencies or omissions discovered by or made known to Contractor as a Request for Interpretation.

1.09 CONTRACTOR DOCUMENTATION OF EXISTING CONDITIONS BEFORE START OF CONSTRUCTION

- A. Owner, Architect and Contractor shall meet and tour project site to inspect existing conditions of the project site, building and Contractor storage, staging and parking areas before start of construction.
- B. Contractor shall perform a full photo and video documentation of existing conditions during the project site tour and meeting with Owner and Architect.
- C. Contractor documentation shall consist of a written report, digital photographs and video recording. Photographs and video recordings shall be noted and referenced from a site plan and building plan drawing.
- D. Contractor shall submit existing conditions inspection report including photographs and video recordings to Architect and Owner on a USB digital electronic storage device.
- E. Documentation will be used at the end of construction to determine extent of damage to existing conditions and what work is required for Contractor to return all existing facilities to same or better condition than it originally existed before start of construction.
- F. Meeting Minutes and Documentation Report: Contractor or contractor designee shall record minutes and documentation report. Contractor shall electronically transmit PDF copies to participants within 2 days after meeting. Meeting minutes and documentation report shall be computer word processed.
 1. Hand written minutes and report not permitted.

1.10 DAMAGE DURING CONSTRUCTION

- A. Any damage caused to existing facilities shall be reported to Architect by Owner and/or Contractor immediately upon occurrence or when first observed. Architect will discuss extent of damage with Owner and Contractor and may make a field visit to inspect and document damage.
- B. Owner and Contractor shall make a written report of observed damage and submit to Architect. Owner's Insurance Provider may make an inspection and prepare a report of damage.
- C. Architect will determine extent of damage and advise Contractor of repairs to be made and date when repairs shall be complete. Decision of Architect is final.
- D. All damage to existing facilities on Project Site caused by Contractor shall be promptly repaired to Owner's satisfaction at Contractor's expense.

- E. At end of construction, return all existing facilities to same or better condition as originally found before Notice to Proceed was issued.

1.11 TEMPORARY FACILITIES, UTILITIES AND CONTROLS

- A. Contractor shall provide all temporary facilities, utilities and controls required for complete construction of the Work.
- B. Contractor shall provide temporary facilities, utilities and controls as directed and approved by Owner, and in accordance with the Agreement between Owner and Contractor/Constructor.
- C. Project Field Superintendent shall inspect and maintain temporary facilities and controls continuously throughout Contract for Construction to the satisfaction of the Owner.

1.12 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.13 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Existing building spaces may not be used for storage.
- D. Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours the site is unoccupied.
 - 2. Prevent accidental disruption of utility services to other facilities and adjacent buildings.
- E. Assume full responsibility for protection and safekeeping of Products under this Contract, stored on site.
- F. Keep Project Site free from accumulations of waste materials or rubbish. At periodic intervals determined by progress of Work, remove waste and rubbish from Project Site. At completion of Project, remove all waste, rubbish, temporary facilities, project signs, tools, equipment, machinery, materials and all other Contractor items.

1.14 WORK SEQUENCE

- A. Construct Work continuously from Notice to Proceed until Substantial Completion.
- B. Construct Work and have Work Substantially Complete and ready for Substantial Completion Inspection on or before the Date of Substantial Completion established in the Notice to Proceed.
 - 1. Submit all Contract Closeout Package items within 14 calendar days after date of Substantial Completion Inspection.
- C. Complete all Substantial Completion Inspection punchlist items ready for Final Completion Inspection no later than 30 days after date of Substantial Completion Inspection.

1.15 CODES AND STANDARDS

- A. All products, materials and construction quality shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. In no case shall work, products, or materials of a lower quality to those specified be provided in this Project, even if permitted by code.
- B. Inspections by Local Authority Having Jurisdiction:

1. Do not enclose or cover any items required to be inspected by Authority Having Jurisdiction until they are inspected and approved by Authority Having Jurisdiction.
2. Notify Authority Having Jurisdiction minimum number of days in advance of inspection as required by Authority Having Jurisdiction to schedule inspection. Verify with Authority Having Jurisdiction representative.
3. Reinspections: Whenever inspection finds that inspected item does not pass, make required corrections and schedule a reinspection.
4. Reports: Prepare and submit inspection reports indicating results of inspections made

1.16 SAFETY

- A. Conduct all operations and all aspects of work in safest possible manner. Comply with all Federal, State and Local Law and Regulations and accepted safe practices for use and storage of flammable, hazardous, toxic and dangerous materials, products or techniques and the health and safety of all Workers.
 1. All fines levied for non-compliance shall be paid by Contractor.
- B. Perform all work in conformance with Occupational Safety and Health Administration regulations contained in U.S. Department of Labor, Standard 29 CFR, Part 1926 "Safety and Health Regulations for Construction"
- C. Contractor shall develop, implement and enforce a Contractor Site Safety Program in conformance with requirements of "Manual of Accident Prevention in Construction" published by Associated General Contractors of America.
- D. Subcontractor Superintendents or Foremen: Each Subcontractor shall have a Superintendent or Foreman at Project site that is proficient in speaking the American English Language at all times when that Subcontractor's workers are working at Project Site. This is a site safety issue and requires clear communication between all persons at Project Site.
 1. It is the responsibility of the Contractor's Project Field Superintendent to check for compliance by each Subcontractor on-site periodically each workday.

1.17 PROJECT MANAGEMENT AND PROJECT COORDINATION

- A. Refer to Section 01 3100 - Project Management and Coordination.
- B. Contractor shall provide the following for this Project in accordance with specified requirements:
 1. Project Manager and Project Field Superintendent.
 2. Maintain Contract Documents, Project Record Documents, Project Record Submittals and Project Superintendent's Daily Log. Document adverse weather days.
 3. Submit detailed Contractor Site Safety Program.
 4. Coordinate all Work including Mechanical, Plumbing, Electrical, Fire Sprinkler and Fire Alarm systems. Prepare coordination drawings as necessary.
 - a. Any rerouting of piping, conduit, ductwork or any other portion of Work due to Contractor failure to coordinate locations of all Work will be at Contractor expense.
 5. Attend, document and prepare Meeting Minutes for Contractor, Architect and Owner Progress Meetings.
 6. Schedule, conduct, document and prepare Meeting Minutes for each Preinstallation Meeting required by each individual technical Specification Section.
 7. Attend, document and prepare Meeting Minutes for Contract Closeout Meeting.

1.18 CONTRACTOR QUALITY CONTROL

- A. Refer to Section 01 4000 - Quality Requirements.
- B. Contractor shall maintain quality control over Contractor personnel, subcontractors, sub-subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work of specified quality.
- C. Contractor shall inspect all work and perform all tests and inspections specified in each individual Specification Section.
- D. Contractor shall continuously inspect Work performed by Contractor personnel, subcontractors and sub-sub-contractors and maintain a Non-Compliance Check-Off List for Work that does not comply with Contract Documents.

1.19 SPECIFICATION FORMAT AND CONTENT

- A. Specification Format: Specifications are organized into Divisions and Sections based on Construction Specifications Institute (CSI) MasterFormat numbering system.
 - 1. Specifications may be written in an abbreviated, or streamline outline, format and may include incomplete sentences. The omission of modifying words or phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the Drawings", "a", "the", "an", and "all" are intentional. Any such omitted word or phrase shall be supplied by inference in the same manner as they are in Drawing notes. The fact that any such word or phrase is present in one statement but is absent from another shall be interpreted to have no meaning and shall be without effect on interpretations of the Contract Documents.
 - 2. Titles to Divisions, Sections and Paragraphs in the Specifications are intended for convenience only and shall not be deemed to be a complete and correct list, or complete segregation, of the various portions of the Work. Neither Owner nor Architect assume responsibility, either direct or implied, for omissions or duplications by the Contractor, or by any Subcontractor, Sub-subcontractor or Material Supplier, or any other entity, based upon the arrangement of the Specifications.
- B. Specification Content: This Specification uses certain conventions in use of language and intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 - 1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated type. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated shall be interpolated as the sense required. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and context of Contract Documents so indicates.
 - 2. Imperative and streamlined language is used generally in Specifications. Requirements expressed in imperative mood are to be performed by Contractor. At certain locations in text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by Contractor, or by others when so noted.
 - a. The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.20 DRAWING FORMAT AND CONTENT

- A. Division of Drawings into numbered or lettered groupings is intended for convenience only and shall not be deemed to be a complete and correct list, or complete segregation, of the various portions of Work. Owner and Architect do not assume responsibility, either direct or implied, for omissions or duplications by Contractor, or by any Subcontractor, Sub-subcontractor or Material Supplier, or any other entity, based upon arrangement of Drawings.
 - 1. Drawings have been divided into groupings based upon the general class of the various portions of the Work.
 - 2. Through submission of bid, Contractor attests and warrants that Contractor and Subcontractors, Sub-subcontractors, Material Suppliers and other entities proposed to perform portions of Work have diligently and carefully studied Drawings and other Contract Documents and have fully compared requirements of the Contract Documents taken as a whole with requirements of a specific Drawing or grouping of Drawings.
- B. The following subparagraph shall be included by reference as a note on each and every Drawing and shall have the same effect as if it had actually been written thereon.
 - 1. Other Drawings, to include Drawings in different groupings, may contain requirements which may seriously impact that portion of the Work described hereon. Examine and carefully study all of the Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 25 00
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 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.

1.02 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions; determination of equivalency.
- B. General requirements and Architect's consideration.
- C. Substitution request package.
- D. Architect's substitution review during procurement.

1.03 RELATED REQUIREMENTS

- A. Section 00 43 25 - Substitution Request Form - During Bidding: Required form for substitution requests made prior to award of contract (During Bidding).
- B. Section 01 30 00 - Administrative Requirements: Submittal procedures, coordination.
- C. Section 01 3300 - Submittal Procedures: Submittal procedures, coordination.
- D. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.04 DEFINITIONS

- A. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
 - 7. Refer to Section 00 43 25 - Substitution Request Form - During Bidding for additional requirements.
- B. Because a Substitution Request is during Procurement (Bidding), a Substitution Request constitutes a request by the submitter for the Architect to make a determination about the equivalency of a manufacturer, product, assembly, material or equipment to that specified in the Bidding Documents and, upon acceptance of the substitution, to add the manufacturer, product, assembly, material or equipment to the Bidding Documents by Addendum.
 - 1. Substitution Time Restrictions:

- a. Time for Substitution Submittal: The Owner / Architect will consider requests for substitutions only if submitted a least 10 business / working days before Bid Date.
 - 1) If the substitution is not received during the specified substitution window, it will be returned unopened.
 - 2) Working Day Definition for this Contract: Monday thru Friday, excluding Saturday, Sunday, Good Friday and the following Federal Holidays; New Year's Day, Birthday of Martin Luther King, Jr., Washington's Birthday, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day and Christmas Day.
2. Substitution Request Form - During Bidding:
 - a. Submit substitution requests by completing the form in Section 00 43 25; see this for additional information and instructions. Use only this form; other submissions are unacceptable.
 - 1) Forms that are not fully filled out or forms that have not been signed will be returned unopened.

3.02 ARCHITECT'S CONSIDERATION

- A. Architect will consider a request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action:
 1. Proposed substitution offers Owner a substantial advantage or savings in cost, time, energy conservation or other consideration.
 2. Specified Product becomes unavailable through no fault of submitter.
 - a. Failure to order the specified product in time to meet completion date is not a reason for substitution.
 3. Proposed substitution does not require extensive revisions to the Contract Documents.
 4. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
 5. Proposed substitution is fully documented and properly submitted.
 6. Proposed substitution will not adversely affect construction schedule.
 7. Proposed substitution has received necessary approvals of authorities having jurisdiction.
 8. Proposed substitution is compatible with other portions of the work.
 9. Proposed substitution has been coordinated with other portions of the work.
 10. Proposed substitution provides specified warranty.
- B. Architect will not consider a request for substitution if the following conditions occur and Architect will return requests without action:
 1. Proposed substitution is not submitted in accordance with the requirements of this section.
 2. Acceptance of proposed substitution will require substantial revision of Contract Documents or building spaces.
 3. Proposed substitution does not indicate specific item request is for.
 4. Proposed substitution requires extensive revisions to the Contract Documents.
 5. Proposed substitution is not consistent with the Contract Documents and will not produce indicated results.
 6. Proposed substitution is not fully documented and properly submitted.
 7. Proposed substitution will adversely affect construction schedule.
 8. Proposed substitution has not received necessary approvals of authorities having jurisdiction.
 9. Proposed substitution is not compatible with other portions of the work.
 10. Proposed substitution has not been coordinated with other portions of the work.
 11. Proposed substitution does not provide specified warranty.
- C. Manufacturers, materials, products and equipment described in the Contract Documents establish a standard of required function, dimension, appearance and quality to be met by any product substitution.
- D. Architect's decision of acceptance or rejection of a proposed substitution is final.

3.03 SUBSTITUTION REQUEST PACKAGE

- A. Prepare a separate Substitution Request Package for each proposed substitution. Package shall be assembled and organized into an easily manageable format and accompanied by transmittal form on proposer's letterhead.
- B. Clearly and legibly identify and complete all items included on Section 00 42 35 - Substitution Request Form - During Bidding.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on submitter.
- D. Content: Include information necessary for tracking the status of each Substitution Request Package, and information necessary to provide an actionable response.
 - 1. Substitution Request Package documentation shall include the following:
 - a. Project Information:
 - b. Official project name and number.
 - 1) Owner's, Architect's and Submitter's names.
 - c. Substitution Request Information:
 - 1) Issue date.
 - 2) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
 - 3) Description of Substitution.
 - 4) Reason why the specified item cannot be provided.
 - 5) Differences between proposed substitution and specified item.
 - 6) Description of how proposed substitution affects other parts of work.
 - 7) Certification on proposer's letterhead that proposed substitution conforms to requirements of Contract Documents in every respect and is appropriate for the applications indicated including a waiver of right to additional payment or time that may subsequently become necessary because of the failure of substitution to perform adequately.
 - d. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Sustainable design features.
 - 6) Warranties.
 - 7) Other salient features and requirements.
 - 8) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - (d) Drawings, when required to show impact on adjacent construction elements.
 - e. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- E. Limit each request to a single proposed substitution item.
 - 1. Submit an electronic document, combining the request form with supporting data into single document.

3.04 SUBSTITUTION PROCEDURES DURING PROCUREMENT (BIDDING)

- A. Submit requests for substitution within the Time for Substitution Submittal as defined in this specification Section.

1. Substitution Requests submitted after Time for Substitution Submittal will be returned to submitter marked "Substitution Arrived Too Late."
 2. Substitution Requests submitted after Time for Substitution Submittal will be returned to Construction Manager marked "Substitution Arrived Too Late."
- B. Submit request for substitution to the Beck Design Project Manager for this project listed in Section 00 01 03 - Project Directory.
- C. Submittal Format:
1. E-Mail Subject Line to Read as Follows: Project Number, Bidder Request for Substitution from [Insert Bidder Company] Regarding [Insert what Product Substitution Request is for].
 2. Body of E-Mail to Include the Following: Project Name, Specification Section relating to Substitution Request, Drawing Number or Drawing Detail Designation relating to Substitution Request.
 3. Submitter Information: Include submitter name, submitter title and submitter company name, indicate whether submitter is a general contractor, sub-contractor or supplier, company address, telephone number and e-mail address.
 4. Attachments to E-Mail: Attach PDF copy of Submitter Transmittal on Submitter Letterhead along with a complete Substitution Request Package.
- D. Submittal Form - During Procurement (before award of contract):
1. Submit substitution requests by completing the form in Section 00 43 25; see this Section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- E. Substitution Request Package: Submit substitution request package along with Section 00 43 25 - Substitution Request Form - During Bidding.

3.05 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Not Permitted.
- B. **It is the responsibility of the Contractor to obtain or purchase approved specified products in a timely manner to avoid delays in the project. A Substitution Request will not be considered for failure to obtain the specified products due to the Contractor's delay in purchasing or failure to adhere to the project schedule.**

3.06 ARCHITECT'S SUBSTITUTION REVIEW DURING BIDDING

- A. Architect will review Substitution Request Package upon receipt to determine if Package is complete and conforms to specified requirements.
1. If Package Does Not conform to specified substitution requirements, submittal will be returned to proposer as indicated below.
 2. If Package conforms to specified substitution requirements, Architect will continue review and notify proposer as indicated below.
 3. During the bidding phase, approved substitutions will be indicated in Addenda for information of all Bidders.
- B. If substitution is Not Approved, submittal form will be returned to proposer marked with one of the following actions:
1. Substitution Rejected - Use specified materials.
 2. Substitution Request arrived too late - Use specified materials.
- C. If substitution is Approved, submittal for will be returned to proposer marked with one of the following actions:
1. Substitution is accepted.
 2. Substitution is accepted with the following comments.

3.07 SUBSTITUTION ACCEPTANCE DURING BIDDING

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into the Bidding Documents for the Project by Addendum.

3.08 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION

**SECTION 01 26 13
REQUESTS FOR INTERPRETATION (RFI)**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Definitions.
- B. Administrative requirements.
- C. Submittal method, RFI form and RFI log.
- D. RFI preparation.
- E. Reason for RFI.
- F. Improper and frivolous RFI's.
- G. RFI content.
- H. Architect's review.
- I. Architect's RFI response.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Owner, Contractor, Architect progress meetings; electronic document submittal requirements.
- B. Section 01 3100 - Project Management and Coordination: Requirements for Contractor/Architect correspondence.
- C. Section 01 4000 - Quality Requirements: Contractor quality control requirements.

1.03 DEFINITIONS

- A. RFI: Requests for Interpretation (RFI), is a formal process used during construction to facilitate communication between Contractor and Architect with regard to requests for interpretation and clarification of the intent of the Contract Documents.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. See Section 01 31 00 - Project Management and Coordination, for project coordination requirements.
- B. Architect will review and respond to requests for interpretation about the Contract Documents. Architect's response to such requests will be made in writing within time limits agreed upon or otherwise with reasonable promptness. If appropriate, Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for interpretation.
- C. A Request for Interpretation (RFI) is seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in the Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- D. Whenever possible, request clarifications at next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary issuance of a formal Request for Interpretation (RFI).
- E. RFI'S and their responses are an agenda item for Owner, Contractor, and Architect Progress Meetings.

1.05 RFI SUBMITTAL METHOD, RFI FORM AND RFI LOG

- A. Submittal Method: Submit Requests for Interpretation (RFI) electronically thru the RFI function of Procore Construction Management system electronic document submittal service specified in Section 01 30 00 - Administrative Requirements.
- B. RFI Form: RFI form is a part of the RFI function of the electronic document submittal service.

- C. RFI Log: RFI log is a part of the RFI function of the electronic document submittal service.
 - 1. Indicates current status of every RFI. Updates log as RFI's are processed.
 - 2. Notes dates of when each request is made and who.
 - 3. Notes dates when a response is received, responded to and by who.
 - 4. Highlights items requiring priority or expedited response.
 - 5. Highlights items for which a timely response has not been received to date.

1.06 RFI PREPARATION

- A. Prepare an RFI immediately upon discovery of a need for interpretation of the Contract Documents. Failure to submit an RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
- B. Prepare a separate RFI for each specific item.
- C. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
- D. Do not forward requests which solely require internal coordination between subcontractors.
- E. Upload PDF attachments into the Procore RFI system and clearly reference the areas where interpretation is being requested.

1.07 REASON FOR RFI

- A. Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
- B. By submitting an RFI the Contractor attests that "Contractor has studied the Contract Documents and has made a good faith effort to determine from the Contract Documents information requiring interpretation."
- C. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - 1. Approval of submittals (see Section 01 33 00 - Submittal Procedures).
 - 2. Approval of substitutions (see Section 01 25 00 - Substitution Procedures)
 - 3. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - 4. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

1.08 IMPROPER AND FRIVOLOUS RFI'S

- A. Improper RFIs: Requests not prepared in conformance to requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
- B. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
- C. Architect will maintain a log of improper and frivolous RFIs.
- D. Owner reserves the right to assess Contractor an Administrative Fee for the costs (on a time-and-materials basis) incurred by Architect, and any of Architect's Consultants, due to processing of such RFIs as specified in Section 01 30 00 - Administrative Requirements.

1.09 RFI CONTENT

- A. Identification and Tracking: Procore Construction Management RFI function includes identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response:
 - 1. Official Project name and number.
 - 2. Owner's, Architect's, and Contractor's names.
 - 3. Consecutive RFI number, and descriptive subject/title.
 - 4. Issue date, and requested reply date.

- B. References: Reference particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
- C. Annotations: Indicate applicable field dimensions and/or description of conditions which have generated the request.
- D. Contractor's Suggested Resolution: Contractor shall provide written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

1.10 ARCHITECT'S REVIEW

- A. Architect will respond to RFIs to Contractor within 14 calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
- B. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes or other official documentation.

1.11 ARCHITECT'S RFI RESPONSE

- A. Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If, in Contractor's belief, it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to Architect, and follow up with an appropriate Change Order request to Architect.
 - 1. Response may include a request for additional information, in which case the original RFI will be considered as having been answered, and a revised RFI shall be issued identified as revised in the Procore RFI function.
 - 2. Do not extend applicability of a response to specific RFI item to encompass other similar conditions, unless specifically so noted in the RFI response.
 - 3. Upon receipt of a response, promptly review and distribute it to all affected parties.
 - 4. Notify Architect within 7 calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 29 00
PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Schedule of values.
- B. Procedures for preparation and submittal of applications for payment.
- C. Payments at Substantial Completion.
- D. Affidavit of Payment of Debts and Claims and Release of Liens form.
- E. Non-Kickback Statement.

1.02 RELATED REQUIREMENTS

- A. Section 00 52 13 - Agreement-Stipulated Sum: Document executed between Owner and Contractor.
- B. Section 00 72 13 - General Conditions: Article 9 Payments and Completion.
- C. Section 01 30 00 - Administrative Requirements: Electronic document submittal service.
- D. Section 01 26 00 - Contract Modification Procedures: Procedures for changes to the Work.
- E. Section 01 29 73 - Schedule of Values: Procedures for schedule of values.
- F. Section 01 32 16 - Construction Progress Schedule: Submittal of updated Construction Schedule.
- G. Section 01 30 00 - Administrative Procedures: Procedures for submittals.
- H. Section 01 70 00 - Closeout Procedures: Requirements to be completed before final payment request package can be submitted.

1.03 PROGRESS PAYMENTS

- A. Based on Applications for Payment submitted to Architect by Contractor and Certificates for Payment issued by Architect, the Owner will make progress payments on account of the Contract Sum to the Contractor.
- B. Period covered by each Application for Payment will be one calendar month ending on the last day of the month.
- C. Provided that Application for Payment is received by Architect no later than the 10th day of a month, the Owner will make payment of the certified amount to Contractor no later than the 15th day of the following month. If an Application for Payment is received by Architect after the 10th day of the month, payment will be made by the Owner no later than 60 days after Architect receives the Application for Payment.
- D. Each Application for Payment shall be based on most recent schedule of values submitted by Contractor in accordance with Contract Documents. Schedule of values shall be prepared and supported by data to substantiate accuracy as required by Architect. Schedule of values will be used as basis for reviewing Contractor's Applications for Payment.
- E. Applications for Payment shall indicate percentage of completion for each portion of Work as of the end of the period covered by Application for Payment.
- F. Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:
 - 1. Take portion of Contract Sum properly allocable to completed Work as determined by multiplying percentage completion of each portion of Work by the share of Contract Sum allocated to that portion of Work in schedule of values, less retainage of 5 percent.
Pending final determination of cost to Owner of changes in Work, amounts not in dispute will be included as provided in Section 7.3.9 of Section 00 73 13 - General Conditions.
 - 2. Add portion of Contract Sum properly allocable to materials and equipment delivered and suitable stored at site for subsequent incorporation in the Work, less retainage of 5 percent.

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3. Subtract aggregate of previous payments made by Owner.
 4. Subtract amounts, if any, that Architect has withheld or nullified in Certificate for Payment as provided in Section 9.5 of Section 00 73 13 - General Conditions.
- G. Progress payment amount determined will be further modified under the following circumstances:
1. Add, upon Substantial Completion of Work, sum to increase total payments to full amount of Contract Sum, less amounts as Architect determines for incomplete Work, retainage to such Work and unsettled claims.
 2. Add, if final completion of Work is materially delayed through no fault of Contractor, any additional amounts payable in accordance with Section 9.10.3 of Section 00 73 13 - General Conditions.
- H. Contractor shall not make advance payments to suppliers for materials or equipment that have not been delivered and stored at site.

1.04 FINAL PAYMENT

- A. All Closeout Documents shall be submitted, reviewed and accepted by Architect before Contractor will be permitted to submit Final Application for Payment.
- B. After Architect determines that Work is final complete and Project Closeout Package is accepted, Contractor may submit Final Application for Payment.
- C. Final payment, constituting the entire unpaid balance of Contract Sum, will be made by Owner to Contractor as follows:
 1. When Contractor has fully performed the Contract except Contractor's responsibility to correct Work as provided in Section 12.2.2 of Section 00 73 13 - General Conditions, and to satisfy other requirements, if any, which extend beyond final payment.
 2. Final Certificate of Payment has been issued by Architect.
- D. Owner's final payment to Contractor will be made no later than 30 days after issuance of Architect's final Certificate of Payment.

1.05 SCHEDULE OF VALUES

- A. See Section 01 29 73 - Schedule of Values, for format and content.

1.06 APPLICATION FOR PAYMENT FORMAT

- A. Forms:
 1. Application for Payment: AIA Document G702 - Application for Payment at end of Section.
 2. Application for Payment - Continuation Form: AIA Document G703 - Continuation Sheet.
 3. Submit on original AIA Document forms or computer generated forms from AIA Electronic Format program. Photocopies of AIA forms Not Permitted.
 - a. Other forms or computer forms not generated from AIA Electronic Format program may or may not be permitted at the discretion of Architect.
 - b. Upon receipt of Notice to Proceed, submit Contractor proposed alternate AIA Document G702 and G703 forms to Architect for review and approval.
 - c. AIA Document G702 and AIA Document G703 are available for purchase from AIA Oklahoma; 6301 Waterford Boulevard, Suite 105 Oklahoma City, Oklahoma 73118 (405) 810-8809.
 4. Submit only typewritten forms. Handwritten forms will not be permitted.
- B. Application for Payment - Continuation Form: Header titles for each column shown as follows shall be used. See AIA Document G703 Application for Payment - Continuation Form.
 1. (A) - Item Number.
 2. (B) - Description of Work.
 3. (C) - Scheduled Values.
 4. (D) - Work Completed: (F) from Previous Applications.
 5. (E) - Work Completed: Work in Place this Application.
 6. (F) - Work Completed: Total Work in Place to Date (D + E).
 7. (G) - Stored Materials: (I) from Previous Applications Less Materials Used this Period.

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8. (H) - Stored Materials: New This Application.
9. (I) - Stored Materials Total Stored Materials (G + H).
10. (J) - Total Completed and Stored to Date.
11. (K) - Percent Completed and Stored to Date (J / C).
12. (L) - Balance to Finish (C - G).
13. (M) - Retainage: (J x 0.05)

1.07 PREPARATION OF APPLICATIONS

- A. All signatures shall be in Blue Ink to clearly identify each document as an original signed document.
- B. Prepare in conformance with Document 00 72 13 - General Conditions, Article 9 Payments and Completion.
- C. Include statement on application as specified in Document 00 72 13 - General Conditions for materials stored on the Project Site but not yet incorporated into Work.
- D. Do not include request for payment for materials stored off Project Site. Architect will not approve and Owner will not pay for any materials stored off Project Site.
- E. Execute certification by signature of Contractor or Contractor authorized officer.
- F. Prepare application on same form and in same format as approved Schedule of Values.
 1. Use data from approved Schedule of Values.
 2. Provide dollar value in each column for each line item for portion of work performed.
 3. Provide an overall project summary percentage complete and payment amount for each Application for Payment as specified in Section 01 29 00 - Payment Procedures.
- G. List each authorized Change Order as an extension on AIA Document G703 - Application for Payment - Continuation Sheet, listing Change Order number and dollar amount as for an original item of Work.
- H. Starting with second Application for Payment, include an executed and notarized Affidavit of Payment of Debts and Claims and Release of Liens with each Application for Payment.
 1. Submittal of Affidavit required by Contractor and each Subcontractor, Sub-subcontractor and material supplier who performed work covered by the Application of the payment period immediately preceding the Application being submitted.
 2. Contractor is responsible to secure and submit proper Affidavits.
 3. Required Affidavit is attached at end of this Section.
 4. Non-Kickback Statement form attached at end of this Section.

1.08 APPLICATION SUBMITTAL PROCEDURES

- A. Submit Application for Payment to Architect on or before specified date. Regardless of Contractor standard billing process, Contractor shall organize and setup billing process for this project as required to allow time to obtain subcontractor invoices, prepare required documents, prepare Application for Payment forms, and transmit Payment Application Package to Architect.
 1. Contractor submittal on or before stipulated date is critical for receiving required approvals, processing and payment by Owner.
 2. Contractor submittal after stipulated date may delay approvals and processing and delay Owner payment.
 3. By failing to submit on or before stipulated date, Contractor expressly assumes risk of all delays to payment and waives all claims for damages or additional payment for any such delays to payment.
- B. Submit executed and notarized original copies of each Application for Payment with original seals and signatures.
- C. Submit updated construction schedule with each Application for Payment.
- D. Transmit each Payment Request Package to Architect with Transmittal Letter.
 1. Transmit to Architect utilizing electronic document submittal service as specified in Section 01 30 00 - Administrative Requirements.
- E. First Payment Request Package shall include the following:

1. Transmittal.
 2. Application for Payment Form - AIA Document G702.
 3. Application for Payment - Continuation Sheet Form - AIA Document G703.
 4. Updated Construction Progress Schedule.
 5. Non-Kickback Statement.
- F. Subsequent Payment Request Package shall include the following:
1. Transmittal.
 2. Application for Payment Form - AIA Document G702.
 3. Application for Payment - Continuation Sheet Form - AIA Document G703.
 4. Stored Material Summary - CSI Form 2.5A, or Architect approved alternate, as applicable.
 5. Updated Construction Progress Schedule.
 6. Contractor Affidavit of Payment of Debts and Claims and Release of Liens.
 7. Affidavit of Payment of Debts and Claims and Release of Liens for each Subcontractor, Sub-subcontractor or material supplier as applicable.
 8. Non-Kickback Statement.
- G. Final Payment Request Package shall include the following:
1. Transmittal.
 2. Application for Payment Form - AIA Document G702.
 3. Application for Payment - Continuation Sheet Form - AIA Document G703.
 4. Affidavit of Payment of Debts and Claims on original executed and notarized copy of AIA Document G706.
 5. Affidavit of Release of Liens on original executed and notarized copy of AIA Document G706A.
 6. Consent of Surety to Final Payment on original executed and notarized copy of AIA Document G707.

1.09 INCOMPLETE OR INCORRECT PAYMENT REQUEST PACKAGE SUBMITTALS

- A. Incomplete Submittals: Processing will stop for Payment Request Packages received by Architect that do not include all required items. Architect will contact Contractor and advise Contractor of missing items. Contractor is responsible for sending Architect items missing from Payment Request Package. Payment processing will not start until Payment Request Package is complete.
- B. Incorrect Submittals: Payment Request Packages that are incorrectly submitted, incorrectly assembled or have incorrect data will be returned to Contractor for correction.
1. Packages submitted on photocopies of AIA forms rather than original AIA forms will be returned to Contractor to prepare on original AIA forms.
 2. Handwritten forms will be returned to Contractor to prepare in typewritten form.
 3. Payment Request Packages with Continuation Sheets containing major incorrect percentage complete numbers may be marked-up and returned to Contractor for correction.
 4. Minor percentage complete numbers may be corrected by Architect and processed with corrected percentages and payment amount.
 5. Determination of whether to return Payment Request Package or to process an Architect mark-up of Payment Request Package is at the discretion of the Architect.
- C. Contractor is responsible for Payment Request Package processing being stopped due to submittal of incomplete or incorrect Payment Request Package.

1.10 SUBSTANTIATING DATA

- A. If Contractor is making application for payment on account of materials and equipment delivered, suitably stored at site for subsequent incorporation in Work and properly invoiced, Contractor shall provide substantiating data showing flow of materials and equipment in and out of storage on a Stored Material Summary form.
- B. When Architect requires substantiating information, submit data justifying dollar amounts in question.

01 29 00 - PAYMENT PROCEDURES

- C. Provide copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.
- D. Include the following with application:
 - 1. Partial release of liens from major subcontractors and vendors.
 - 2. Section 01 32 16 - Construction Progress Schedules; Revise and include current construction schedule.

1.11 SUBSTANTIAL COMPLETION

- A. It is the duty, responsibility and obligation of Contractor to achieve Substantial Completion within Contract Time stipulated in Document 00 52 13 - Agreement-Stipulated Sum, and the Notice to Proceed.
- B. If Contractor does not achieve Substantial Completion within Contract Time, Owner may suspend further Progress Payments until Work is Substantially Complete as determined by Architect.
- C. If Contractor does not achieve Substantial Completion within 30 calendar days after expiration of Contract Time, Contract Sum will be adjusted as provided in Document 00 72 13 - General Conditions in direct relation to true and accurate additional direct costs incurred by Owner, including Architect's additional fees.
- D. Contractor expressly assumes risk of all delays to Work and waives all claims for damages or additional payment for any such delays to Work.
- E. Nothing in Contract Documents limit Owner's full rights and remedies as allowed by law should delays in Work exceed 30 calendar days beyond Contract Time as established in the Agreement.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 29 73
SCHEDULE OF VALUES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Schedule of values.

1.02 RELATED REQUIREMENTS

- A. Section 01 29 00 - Payment Procedures: Applications for payment.
- B. Section 01 42 00 - References: Definitions.
- C. Section 01 60 00 - Product Requirements: Substitution requirements.

1.03 SUBMITTALS

- A. Section 01 30 00 - Administrative Requirements: Requirements for submittals.
- B. Submit a printed schedule on AIA Form G703 - Application and Certificate for Payment Continuation Sheet itemizing all contract costs with breakdown as specified herein.
- C. Submit three copies of Schedule of Values within 10 days of Notice to Proceed.
- D. Failure of Contractor to submit complete and accurate Schedule of Values within specified time and as specified in this Section will cause processing of Contractor Payment Request Packages to stop. Payment processing will not start until Schedule of Values has been submitted, reviewed and accepted by Architect.

1.04 SCHEDULE OF VALUES

- A. Contractor is responsible for and shall provide a complete and detailed accounting to Owner of all Contractor costs for this Project. Owner requires that Contractor indicate where each dollar of Contract Sum is allocated.
- B. The Schedule of Values will be used by Architect as a basis for reviewing Contractor's Applications for Payment.
- C. Schedule of Values shall be broken down by Document and Specification utilizing Table of Contents of this Project Manual. Identify each line item with number and title of Document or Specification Section.
- D. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- E. Revise schedule as necessary to reflect approved Change Orders with each Application for Payment.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Progress meetings.
- F. Construction progress schedule.
- G. Contractor's daily reports.
- H. Progress photographs.
- I. Coordination drawings.
- J. Submittals for review, information, and project closeout.
- K. Number of copies of submittals.
- L. Requests for Interpretation (RFI) procedures.
- M. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: General product requirements.
- B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
- C. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 REFERENCE STANDARDS

- A. AIA G716 - Request for Information; 2004.
- B. AIA G810 - Transmittal Letter; 2001.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. Contractor and Architect are required to use this service.
 - 3. It is Contractor's responsibility to submit documents in allowable format.
 - 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
 - 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 - 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 - 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is:
 - 1. Procore Construction Software
- C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

- A. Schedule meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 - 5. Designation of personnel representing the parties to Contract and Architect.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 7. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

- A. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's superintendent.
 - 5. Major subcontractors.
- B. Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements.
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Survey and building layout.
 - 6. Security and housekeeping procedures.
 - 7. Schedules.
 - 8. Application for payment procedures.
 - 9. Procedures for testing.
 - 10. Procedures for maintaining record documents.
 - 11. Requirements for start-up of equipment.
 - 12. Inspection and acceptance of equipment put into service during construction period.
- C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's superintendent.
 - 5. Major subcontractors.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of RFIs log and status of responses.
 - 7. Review of off-site fabrication and delivery schedules.
 - 8. Maintenance of progress schedule.
 - 9. Corrective measures to regain projected schedules.
 - 10. Planned progress during succeeding work period.
 - 11. Coordination of projected progress.
 - 12. Maintenance of quality and work standards.
 - 13. Effect of proposed changes on progress schedule and coordination.
 - 14. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 32 16

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.06 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
 - 1. Completion of site clearing.
 - 2. Excavations in progress.
 - 3. Foundations in progress and upon completion.
 - 4. Structural framing in progress and upon completion.
 - 5. Enclosure of building, upon completion.
 - 6. Final completion, minimum of ten (10) photos.
- E. Take photographs as evidence of existing project conditions as follows:
 - 1. Interior views.
 - 2. Exterior views.
- F. Views:
 - 1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 - 2. Consult with Architect for instructions on views required.
 - 3. Provide factual presentation.
 - 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- G. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
 - 1. Delivery Medium: Via email.
 - 2. File Naming: Include project identification, date and time of view, and view identification.
 - 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 - 4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.07 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.

3.08 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.

2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 2. Prepare in a format and with content acceptable to Owner.
 - a. Use AIA G716 - Request for Information .
 3. Prepare using software provided by the Electronic Document Submittal Service.
 4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 2. Owner's, Architect's, and Contractor's names.
 3. Discrete and consecutive RFI number, and descriptive subject/title.
 4. Issue date, and requested reply date.
 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 - 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 - 2. Note dates of when each request is made, and when a response is received.
 - 3. Highlight items requiring priority or expedited response.
 - 4. Highlight items for which a timely response has not been received to date.
 - 5. Identify and include improper or frivolous RFIs.
- H. Review Time: Architect will respond and return RFIs to Contractor within fourteen (14) calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
 - 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 - 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 - 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 - 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 - 4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.09 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 - 1. Submit at the same time as the preliminary schedule specified in Section - 01 32 16 - Construction Progress Schedule.
 - 2. Coordinate with Contractor's construction schedule and schedule of values.
 - 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
 - 4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 - 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.10 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout

Submittals.

3.11 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.12 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.13 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.14 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Use a separate transmittal for each item.
 - 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 - 3. Transmit using approved form.
 - a. Use Form AIA G810.
 - 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 - 5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - 6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 - 7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Upload submittals in electronic form to Electronic Document Submittal Service website.
 - 8. Schedule submittals to expedite the Project, and coordinate submission of related items.

- a. For each submittal for review, allow fourteen (14) days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 10. Provide space for Contractor and Architect review stamps.
 11. When revised for resubmission, identify all changes made since previous submission.
 12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 14. Submittals not requested will not be recognized or processed.
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Do not reproduce Contract Documents to create shop drawings.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
 4. In some instances, the Architect may choose to provide background drawings to facilitate shop drawings. This may be allowed when requested by the Contractor and will be at the SOLE discretion of the Architect whether to do so. If the Architect elects to transmit background drawings, he will charge an appropriate fee to compensate for administrative costs. the fee will be determined at the time of the request based on the scope of the request.
- D. Samples Procedures:
1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

3.15 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- D. Architect's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 - 2) Non-responsive resubmittals may be rejected.

01 30 00 - Administrative Requirements

2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - 2) Non-responsive resubmittals may be rejected.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

**SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Management and Supervisory Personnel.
- B. Administrative fee.
- C. Contractor quality control.
- D. Record keeping, documentation and reporting.
- E. Coordination drawings.
- F. Project coordination.
- G. Mechanical and electrical coordination.
- H. Project meetings.

1.02 RELATED REQUIREMENTS

- A. Section 01 11 00 - Summary: Safety and Contractor site safety plan.
- B. Section 01 26 00 - Contract Modification Procedures: Supplementary Instructions, Proposal Requests, Construction Change Directives and Change Orders.
- C. Section 01 30 00 - Administrative Requirements: Procedures for Requests for Interpretation of Contract Documents, pre-construction, site progress, pre-installation and contract closeout meetings.
- D. Section 01 40 00 - Quality Requirements: Contractor quality control responsibilities.
- E. Section 01 70 00 - Execution Requirements:
- F. Section 01 77 00 - Closeout Requirements:
- G. Section 01 78 00 - Closeout Submittals: Project record documents and project record submittals.

1.03 PROJECT MANAGEMENT AND SUPERVISORY PERSONNEL

- A. Project Manager: Experienced in administration, supervision, and quality control of earthwork, grading, site work, site utilities, and new and/or alteration building construction, including mechanical and electrical work as required for this Project.
- B. Project Field Superintendent:
 - 1. Refer to Document 00 72 13 - General Conditions, Paragraph 3.9 Superintendent.
 - 2. Contractor shall employ a competent Project Field Superintendent and necessary assistants who shall be in attendance at Project Site full time during performance of Work.
 - a. Full time requires superintendent to be at Project Site from 7:00 AM to 4:00 PM Monday thru Friday, except holidays, and at any other time that Work is being performed, subcontractors or suppliers are on site, including evenings, weekends and holidays.
 - b. Administrative Fee: Contractor failure to provide specified Project Field Superintendent will result in Owner assessing and Administrative Fee as specified in this Section.
 - c. Proficiency in English: This is a project communication and site safety issue.
 - 1) Project Field Superintendent shall be proficient in speaking, reading and writing the American English Language.
 - 2) Each Subcontractor Superintendent or Foreman shall be proficient in speaking the American English Language.
 - 3. Owner and Architect will review the experience and qualifications of proposed Project Field Superintendent.
 - a. Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection.

4. Project Field Superintendent shall represent Contractor, and communications given to Project Field Superintendent shall be as binding as if given to Contractor.
 - a. Important communications shall be confirmed in writing.
 - b. Other communications shall be similarly confirmed on written request in each case.
5. Project Field Superintendent Shall:
 - a. Be experienced in general field supervision and quality control of earthwork, grading, site work, site utilities, and new and/or alteration building construction, including mechanical and electrical work as required for this Project.
 - b. Supervise, direct, inspect and coordinate work of Contractor, subcontractors, suppliers and installers, and expedite Work to assure compliance with Contract Document requirements and Construction Schedules.
 - c. Enforce Contractor Site Safety Plan requirements.
 - d. Perform Contractor Quality Control Representative responsibilities as specified in Section 01 40 00 - Quality Requirements.
 - e. Project Field Superintendent shall not be removed from the Project or replaced with another Project Field Superintendent except as defined within Document 00 72 13 - General Conditions, Clause 3.9.3 or at the request of the Owner.

1.04 CONTRACTOR QUALITY CONTROL

- A. Perform project quality control in accordance with requirements specified Section 01 40 00 - Quality Requirements.
 1. Monitor quality control over construction workers, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship.
 2. Comply with product manufacturers instructions.
 3. Monitor construction worker qualifications to ensure that Work is performed by persons qualified to produce the required and specified quality.
 4. Test and inspect Work provided under this Contract to ensure Work is in compliance with Contract documents as specified in individual Specification Sections.
 5. Prepare Contractor Test and Inspection Reports for each inspection or test and submit to Architect.
 6. Maintain a Non-Compliance Check-Off List for Work that does not comply with Contract Documents and oversee corrections in construction to bring Work into compliance with Contract Documents.
 7. Maintain and keep current Project Record Documents as specified in Section 01 78 00 - Closeout Submittals.
 8. Maintain and keep current Project Record Submittals as specified in Section 01 78 00 - Closeout Submittals.
- B. Coordinate scheduling of inspection and testing required by individual specification Sections and in accordance with Section 01 40 00 - Quality Requirements.

1.05 RECORD KEEPING, DOCUMENTATION AND REPORTING

- A. Maintenance of Contract Documents on Site: Maintain one copy of all Drawings, Specifications, Addenda, Approved Shop Drawings, Change Orders and other modifications, in good order and marked to record all field changes made during construction as specified in Section 01 78 00 - Closeout Submittals, Article entitled "Project Record Documents.
- B. Maintenance of Project Record Submittals: Maintain one copy of all reviewed and accepted Shop Drawings, Product Data and Samples that were submitted to and received back from Architect as specified in Section 01 78 00 - Closeout Submittals, Article entitled "Project Record Submittals." Maintain Project Record Submittals in Contractor's Office, not at Project Site.
- C. Project Field Superintendent's Daily Log: Project field superintendent shall keep a chronological daily log to record day-to-day accounting of work force, activities performed, weather conditions and any specific events that take place on Project Site.
 1. Include the following information in Daily Log:
 - a. Date.
 - b. Weather, temperature, wind and precipitation.

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- c. Number of workers on site by subcontractor and trade.
 - d. Material and equipment deliveries.
 - e. Construction quantities placed.
 - f. General description of Work accomplished.
 - g. Specific problems encountered.
 - h. Meetings held.
 - i. Test and/or inspections made and by who.
 - j. List of Project Site visitors and their companies.
2. Contractor's Daily Log shall be computer word processed in Microsoft Word format.
 - a. Hand written logs not permitted.
 3. Architect may require submission of Contractor's Daily Log to be attached to Contractor's monthly Payment Request Package.
 - a. Contractor failure to include requested Contractor's Daily Log in Payment Request Package will cause processing of Application for Payment until Contractor's Daily Log is received by Architect.

1.06 SUBMITTALS

- A. Site Safety Plan: Submit detailed Contractor Site Safety Program and implementation plan indicating compliance with Federal and State General and Construction Industry specific Occupational Safety and Health Administration regulations; U.S. Department of Labor, Standard 29 CFR, Part 1926 "Safety and Health Regulations for Construction," Associated General Contractors of America "Manual of Accident Prevention in Construction" and other applicable standards.
- B. Requests for Interpretation: Submit Requests for Interpretation of Contract Documents in accordance with Section 01 30 00 - Administrative Requirements.
- C. Items Identified as Submittals in Specification Sections: Submit shop drawings, product data and other required submittals in accordance with Section 01 30 00 - Administrative Requirements.

1.07 PROJECT COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
- D. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- E. Cooperate with the Owner Representative in allocation of mobilization areas of site; for field offices and sheds, storage, for vehicular access and parking facilities.
- F. During construction, coordinate use of site and facilities through the Owner Representative.
- G. Comply with procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- H. Comply with instructions of the Owner Representative for use of temporary utilities and construction facilities.
- I. Testing and Inspections: Coordinate scheduling and preparation for all testing and inspections.
- J. Where conflicts occur Contractor shall submit a Request for Interpretation (RFI) to Architect and receive Architect response before continuing Work. Submit Request for Information as specified in Section 01 30 00 - Administrative Requirements.

01 31 00 - PROJECT MANAGEMENT AND COORDINATION

1.08 PROJECT MEETINGS

A. Specified in Section 01 30 00 - Administrative Requirements.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.02 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.
- F. Submit in PDF format.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate stages and other logically grouped activities.
- D. Provide sub-schedules for each stage of Work identified in Section 01 10 00 - Summary.
- E. Provide sub-schedules to define critical portions of the entire schedule.
- F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- G. Indicate delivery dates for owner-furnished products.
- H. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

3.05 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

**SECTION 01 40 00
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Control of installation.
- F. Mock-ups.
- G. Tolerances.
- H. Manufacturers' field services.
- I. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 01 43 39 - Mock-up Wall Construction

1.03 DEFINITIONS

- A. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:
 - a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
 - b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- B. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

- C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- E. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
 - 1. Submit report in duplicate within 30 days of observation to Architect for information.
 - 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
- F. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.06 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.07 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ and pay for services of an independent testing agency to perform specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 - 1. Make corrections as necessary until Architect's approval is issued.
- H. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. Testing Agency Duties:

1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

**SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Dewatering
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Vehicular access and parking.
- F. Waste removal facilities and services.
- G. Project identification sign.

1.02 RELATED REQUIREMENTS

- A. Section 01 58 13 - Temporary Project Signage.

1.03 DEWATERING

- A. Provide temporary means and methods for dewatering all temporary facilities and controls.
- B. Maintain temporary facilities in operable condition.

1.04 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - 2. Internet Connections: Minimum of one; DSL modem or faster.
 - 3. Email: Account/address reserved for project use.
 - 4. Facsimile Service: Fax-to-email software on personal computer.

1.05 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Designated existing on-site roads may be used for construction traffic.

- F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.08 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site weekly.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.09 PROJECT SIGNS - SEE SECTION 01 58 13

1.10 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Construction procedures to promote adequate indoor air quality after construction.
- B. Building flush-out after construction and before occupancy.
- C. Testing indoor air quality after completion of construction.

1.02 PROJECT GOALS

- A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
 - 1. Cleaning of ductwork is not contemplated under this Contract.
 - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
- B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
 - 1. Furnish products meeting the specifications.
 - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.03 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.04 REFERENCE STANDARDS

- A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).
- B. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction; 2007.

1.05 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.06 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: Independent testing agency having minimum of 5 years experience in performing the types of testing specified.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Low VOC Materials: See Section 01 61 16.
- B. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.
- C. Auxiliary Air Filters: MERV of 8, minimum, when tested in accordance with ASHRAE Std 52.2.

PART 3 EXECUTION

3.01 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.

2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.
- D. HVAC equipment and supply air ductwork may be used for ventilation during construction:
1. Operate HVAC system on 100 percent outside air, with 1.5 air changes per hour, minimum.
 2. Ensure that air filters are correctly installed prior to starting use; replace filters when they lose efficiency.
 3. Do not use return air ductwork for ventilation.
 4. Seal return air inlets or otherwise positively isolate return air system to prevent recirculation of air; provide alternate return air pathways.
- E. Do not store construction materials or waste in mechanical or electrical rooms.
- F. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
1. Inspect duct intakes, return air grilles, and terminal units for dust.
 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
 3. Clean tops of doors and frames.
 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 5. Clean return plenums of air handling units.
 6. Remove intake filters last, after cleaning is complete.
- G. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- H. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

END OF SECTION

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 01 40 00 - Quality Requirements: Product quality monitoring.
- C. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- D. Section 01 74 19 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. See Section 01 40 00 - Quality Requirements, for additional source quality control requirements.
- C. Use of products having any of the following characteristics is not permitted:
- D. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 61 16.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 25 00 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.

01 60 00 - Product Requirements

- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

**SECTION 01 61 16
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.

1.02 DEFINITIONS

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Interior paints and coatings applied on site.
 - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
 - 1. Concrete.
 - 2. Clay brick.
 - 3. Metals that are plated, anodized, or powder-coated.
 - 4. Glass.
 - 5. Ceramics.
 - 6. Solid wood flooring that is unfinished and untreated.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).
- C. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- D. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- E. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.04 SUBMITTALS

- A. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

1.05 QUALITY ASSURANCE

- A. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS

- A. VOC-Content-Restricted Products: VOC content not greater than required by the following:
 - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
 - 2. Joint Sealants: SCAQMD 1168 Rule.
 - 3. Paints and Coatings: Each color; most stringent of the following:
 - a. 40 CFR 59, Subpart D.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

**SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, _____.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls: Temporary exterior enclosures.
- B. Section 01 50 00 - Temporary Facilities and Controls: Temporary interior partitions.
- C. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- D. Section 07 84 00 - Firestopping.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
 - 6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Effect on work of Owner or separate Contractor.
 - f. Written permission of affected separate Contractor.
 - g. Date and time work will be executed.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained

and experienced in collecting and recording accurate data relevant to ongoing construction activities,

- B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.
- C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.05 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- G. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.
- H. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.

- D. Control datum for survey is that indicated on drawings.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- H. Utilize recognized engineering survey practices.
- I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- K. Periodically verify layouts by same means.
- L. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
 - 2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if

- necessary for successful application of new finish.
4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 4. Verify that abandoned services serve only abandoned facilities.
 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
 3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.

- B. Openings in acoustically significant construction, shall be patched to be airtight and have similar surface weight compared to surrounding construction.
- C. See Alterations article above for additional requirements.
- D. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- E. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.
- F. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- G. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- H. Restore work with new products in accordance with requirements of Contract Documents.
- I. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- J. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material, to full thickness of the penetrated element.
- K. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and Owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.

- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect and Owner.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

**SECTION 01 78 00
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 3. Field changes of dimension and detail.
 4. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Additional information as specified in individual product specification sections.
- D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.

- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- K. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Operation and maintenance data.
 - c. Field quality control data.
 - d. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and

name of responsible company principal.

- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

- A. Remove the entire building designated on Drawings.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Provide, erect, and maintain temporary barriers and security devices.
 - 3. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 5. Do not close or obstruct roadways or sidewalks without permit.
 - 6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Do not begin removal until built elements to be salvaged or relocated have been removed.

- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site and legally dispose.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 04 27 23
THROUGH-WALL AND WALL SUBSTRATE FLASHING SYSTEM**

PART 1 - GENERAL

1.01 GENERAL

- A. Contractor shall review American Concrete Institute 530.1 mandatory specification checklist for additional requirements necessary for specific project.
- B. Flashing system shall be provided and installed by a qualified waterproofing contractor.
- C. Contractor shall provide a photo manifest of through-wall installation, including all starts, stops, and transitions in plane.
- D. It is the intent of this specification that the new work will provide a watertight facility (restricted to the location where work is to be performed). The attached specifications describe the minimum acceptable standards of construction and finish.
- E. Contractor shall water test all through-wall flashings once veneer is twelve inches (12") above installed flashing. Coordinate test with Architect and Consultant.
- F. Manufacturer of cloak flashing shall have a representative inspect the installed work a minimum of two times per week. The representative shall not be the installer.
- G. All vertical flashing to be installed full height of the vertical surface.
- H. Refer to Spec Section 08 41 13 for aluminum window coordination.
- I. The design intent is to have windows installed, flashed and water tested prior to veneer installation.

1.02 QUALITY ASSURANCE

- A. At a scheduled pre-construction meeting with all trades, contractor shall review flashing for the project and how the flashing shall be sequenced with the following: below grade waterproofing, air and vapor system, window installation, sealant installation, relief angles and roofing.
- B. Membrane being utilized shall be compatible with all wall materials.

1.03 SUBMITTALS

- A. Shop Drawings: Contractor shall provide from the manufacturer a review of the flashing design for the project and location of preformed shapes on reduced floor plan.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened containers and rolls with all labels intact and legible including labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.
- B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be a minimum of four inches (4") off the substrate, and the tarpaulin tied off with rope.
- C. Deliver materials in sufficient quantity to allow continuity of work.
- D. Handle and store material in such a manner as to avoid damage.
- E. Protect materials against damage by construction traffic.
- F. Storage: All materials should be stored under cover to avoid site damage. During cool weather construction, store materials inside at 50° F or higher.
- G. The proper storage of materials is the sole responsibility of the contractor and damaged materials shall be discarded, removed from the project site, and replaced prior to application.

1.05 SITE CONDITIONS

- A. Job Condition Requirements: Coordinate the work of the contractor with the work to be performed by the Owner's personnel, to ensure proper sequencing of the entire work. The contractor shall follow local, state, and federal regulations, safety standards, and codes. When

a conflict exists, use the stricter document.

- B. Protection of Work and Property:
 - 1. Work: The contractor shall maintain adequate protection of all his work from damage and shall protect the Owner's and adjacent property from injury or loss arising from this contract. He shall provide and maintain at all times any OSHA required danger signs, guards, and/or obstructions necessary to protect the public and his workmen from any dangers inherent with or created by the work in progress. All federal, state, and city rules and requirements pertaining to safety and all EPA standards, OSHA standards, NESHAP regulations shall be fulfilled by the contractor as part of his proposal.
 - 2. Property: Protect existing planting and landscaping as necessary or required to provide and maintain clearance and access to the work of this contract. Examples of two categories or degrees of protection are generally as follows: a) removal, protection, preservation, or replacement and replanting of plant materials; b) protection of plant materials in place, and replacement of any damage resulting from the contractor's operations.
- C. Damage to Work of Others: The contractor shall repair, refinish, and make good any damage to the building or landscaping resulting from any of his operation. This shall include, but is not limited to, any damage to plaster, tile work, wall covering, paint, ceilings, floors, or any other finished work. Damage done to the building, equipment, or grounds shall be repaired at the successful contractor's expense holding the Owner harmless from any other claims for property damage and/or personal injury.
- D. Measurements: It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of same. Any drawings supplied are for reference only.
- E. Cleaning and Disposal of Materials:
 - 1. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean.
 - 2. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust. At completion, all work areas shall be left clean and all contractor's equipment and materials removed from the site.
 - 3. Debris shall be deposited at an approved disposal site.

1.06 WARRANTY

- A. Flashing Manufacturer: Project shall be installed in such a manner that the flashing material manufacturer will furnish a written ten (10) year materials warranty from the date of substantial completion of the completed project.

PART 2 - PRODUCTS

2.01 BUILT-IN FLASHING MEMBRANE (ELVALOY® SHEET)

- A. The built-in flashing membrane shall be 40 mil flexible sheet material, consisting of a blend of elastomeric and thermal plastic polymers, incorporating DuPont® Elvaloy® The membrane shall be reinforced with synthetic fibers, calendered into sheet form, rolled and cut to width.
- B. Cloaks shall be pre-formed, three dimensional flexible units used for detail corners, level changes, stop ends, and special applications.

Elongation	175%	ASTM D412
Tensile Strength	650 psi	ASTM D412
Tear Strength	280 psi	ASTM D624
Low Temperature Flexibility	-25° F Pass	ASTM D146
Water Absorption	Less than 0.1%	ASTM D471

- C. Cloak color shall be as selected by Architect and/or shall match mortar color. Reference manufacturer's list of colors for selection.

2.02 RELATED MATERIALS FOR BUILT-IN FLASHING MEMBRANE

- A. Flashing Membrane Adhesive: Flashing adhesive exceeds the requirements of TTS00230C Type II, Class B, ASTM C 92094 and Canadian Spec CAN 19, 13M82. The product is terra cotta (dull red) in color.

Hardness Shore A	24 ± 3	ASTM C 661
Shear Strength	75 psi	ASTM D 1002
Tack Free Time	25 minutes	ASTM C 679
Slump (sag)	Zero slump	ASTM C 697
Shrinkage	No measurable shrinkage after 14 days	
	AFTER 14 DAYS	
Low Temperature Flexibility	-20° F pass 1/4 inch mandrel	
Service Temperature	-40° F to 200° F continuous service	
Shelf Life	One year	

2.03 SURFACE-ADHERED WITH DRIP FLASHING MEMBRANE (ELVALOY® SHEET)

- A. Surface-adhered with drip membrane shall be a composite 40 mil membrane consisting of 25 mils of elastomeric/thermal plastic membrane incorporating DuPontä Elvaloy® and 15 mils of SBS asphaltic adhesive. The membrane shall be reinforced with synthetic fibers, calendered into sheet form, rolled and cut to standard widths.
- B. Standard Sheet Dimensions:
 1. Thickness 40 mil
 2. Roll length 75 ft
 3. Roll widths 12, 18, 24, 36 in
- C. Cloaks shall be pre-formed, three dimensional flexible units used for detail corners, level changes, stop ends, and special applications.

Elongation	225%	ASTM D412
Tensile Strength	875 psi	ASTM D412
Tear Strength	270 psi	ASTM D624
Low Temperature Flexibility	-25° F Pass	ASTM D146
Water Absorption	Less than 0.1%	ASTM D471

2.04 RELATED MATERIALS FOR SURFACE ADHERED FLASHING MEMBRANE

- A. Asphalt Primer: Shall be a two-sided, self-adhering tape used to seal the top of cloaks against the back-up wythe. Adhesive may be used as an alternative.

- B. Primer:

<u>Physical Properties</u>		
Solids by Weight	68%	
Viscosity	758 cps	
Weight per Gallon	9.3 lbs.	
Elongation	>656% no Breakage, Exceeded Travel of Instron	ASTM D 2370
Tensile Strength	85.1 psi	ASTM D 2370
pH	10	
Hardness Shore A	59	
Peel Strength	Aluminum No Fail at 4.60 pli	
	Concrete No Fail at 3.86 pli	

- C. Mastic: Shall be used at all laps and joints, and top terminations.
- D. Fiberglass Coated membrane/mesh: Shall be used in three course termination locations. A non- rotting, non-absorbent woven fiberglass membrane/mesh having a vinyl coating designed

for membrane reinforcement. Compatible with asphaltic bitumen, having ten (10) open-weave squares per inch.

2.05 WALL DRAINAGE SYSTEM

- A. Collection device shall be a dovetail shaped material to place in the cavity of brick masonry walls for collecting mortar droppings above the level of the weep holes and flashing. The 90% open weave construction material shall be High Density Polyethylene (HDPE) mesh for thickness of 0.4 – 1.0 inch, or recycled polyester mesh for 2.0 inch thickness.
- B. Material shall not oxidize, rot, promote mold or fungus, or react with other common building materials such as mortar, cement, asphalt, modified bitumen, PVC, copper, or galvanized metal; shall be Mortar Net, or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other specific conditions.

3.02 GENERAL

- A. Laying Masonry Walls: Use an inverted lintel CMU or fully grouted hollow CMU as a base for flashing at sills, floor joints, and other similar conditions.
- B. Preparation: All sharp protrusions and mortar droppings must be removed from the substrate, and the surface must be clean and dry.
- C. Where brick work occurs about the roof elevation, provide solid protection of the existing roof system until work is complete.
- D. Flashing shall be fully supported when crossing the cavity except at sill and coping locations.
- E. Flashing shall be fully adhered around all wall penetrations prior to veneer installation.

3.03 INSTALLATION OF BUILT-IN FLASHING MEMBRANE (ELVALOY® SHEET)

- A. Flashing membrane and cloaks shall be installed in a bed of fresh mortar and should extend through the outer wythe a minimum of one-fourth inch (1/4") and left exposed. Flashing membrane is UV resistant.
- B. Weep holes shall be provided immediately above all flashing at 24-inch centers. A minimum of two weeps shall be installed above any wall opening.
- C. All joints in the flashing membrane shall be lapped a minimum of four inches (4") using flashing membrane adhesive.
- D. Flashing membrane shall be installed six inches (6") above finished grade level.
- E. Cloaks and end dams shall be installed at all window and door heads and sills.
- F. Vertical flashing at wall openings shall extend into the wall opening four inches (4"). The door/window frame shall be installed with the flashing extending onto the back of the frame.
- G. Cleaning: Flashing membrane shall not be damaged by cavity cleaning after installation. Precautions to be taken during subsequent work are:
 - 1. Use of cavity battens to prevent mortar droppings;
 - 2. Removal of droppings before they harden;
 - 3. Never use implements such as steel rods for cleaning the cavity; and
 - 4. Inspection of cavity flashing for damage as the work proceeds.

3.04 INSTALLATION OF SURFACE-ADHERED FLASHING WITH DRIP MEMBRANE (ELVALOY® SHEET)

- A. Priming: All flashing substrates shall be primed. Flashing primer shall be applied with a brush, roller or sprayed. Coverage is approximately 400 square feet per U.S. gallon (3.78L). Drying time may vary depending on temperature, humidity, and air movement; drying time should be approximately 45 minutes.

- B. Flashing System Installation: Starting at a corner, mount cloak to substrate flashing adhesive. Cut surface adhered membrane into workable sections (8'-10'). Remove the release sheet and adhere the membrane to the inner leaf of construction lapping the membrane onto the cloak four inches (4"). Use firm hand pressure and a steel roller to totally adhere membrane in place. Extend membrane completely through the outer leaf and leave it exposed one-fourth inch (1/4") minimum. The surface-adhered membrane is UV resistant. Apply a bead of flashing mastic to all top termination edges.
- C. Termination Bar: The surface-adhered membrane shall be installed using a termination bar for additional attachment to the inner leaf (optional). Termination bar shall be made watertight using three-course fabric and mastic as detailed and specified.
- D. Weep holes shall be provided immediately above all flashing at 24-inch centers. A minimum of two baffle weeps shall be installed above any wall opening.
- E. Flashing membrane shall be installed six inches (6") above finished grade level.
- F. Stop end cloaks shall be installed at all windows, door heads, sills, and through-wall starts, stops, steps, etc.
- G. Enveloped vertical flashing at wall openings shall extend onto the window unit one inch (1"). The door/window frame shall be installed with the flashing extending onto the back of the frame.
- H. Enveloped vertical flashing shall be installed at all abutments of dissimilar exterior wall treatments: inside and outside nineties (90°), etc.
- I. Cleaning: Flashing membrane shall not be damaged by cavity cleaning after installation. Precautions to be taken during subsequent work are:
 - 1. Use of cavity battens to prevent mortar droppings;
 - 2. Removal of droppings before they harden;
 - 3. Never use implements such as steel rods for cleaning the cavity; and
 - 4. Inspection of cavity flashing for damage as the work proceeds.

3.05 INSTALLATION OF WALL DRAINAGE SYSTEM

- A. Collection device shall be placed vertically on top of the flashing inside the wall cavity where it shall catch and permanently suspend mortar droppings above the level of the weep holes and flashing. The dovetail shape shall prevent mortar droppings from forming a continuous dam and shall allow water and air to rapidly and easily move through the material to the weeps.

3.06 FLASHING MEMBRANE ADHESIVE

- A. Application:
 - 1. Flashing adhesive shall be applied to clean, dry and relatively smooth surfaces.
 - 2. When joint two (2) pieces of flashing membrane, or joining flashing membrane to Cloaks:
 - a. Apply two (2) one-fourth inch (1/4") beads of adhesive approximately one-half inch (1/2") and one and one-half inch (1-1/2"), respectively, from the edge of the bottom membrane along the entire width of the bottom membrane. Overlap the top membrane over the bottom membrane two inches (2") and roll lap with steel hand roller, causing excess to extrude the entire length of the overlap.
 - 3. Do not remove excess adhesive.
- B. Safety, Storage and Handling: Keep container tightly closed when not in use. Store at room temperature. Clean up tools and hands with waterless hand cleaner.

3.07 SUBSTRATE PRIMER

- A. Surface Preparation: Areas to be primed should be dry.
- B. Application: may be applied using a soft roller or brush. It can be removed from masonry with soapy water while wet and a solvent-based cleaner if dry (mineral spirits or citrus cleaner).
- C. Coverage: Depending on the condition of the surface, coverage may vary from as little as 150 square feet to 200 square feet per gallon.
- D. Caution:

04 27 23 - THROUGH-WALL AND WALL SUBSTRATE FLASHING SYSTEM

1. Primer should not be applied when temperatures are below 40° F or when rain is imminent.
2. Keep substrate primer from freezing.
3. During hot weather, the product should be stored in a cool shaded area.
4. Do not thin this product.
5. Curing rates will vary depending on the ambient temperature relative humidity, wind speed, sky condition and the proper rate of application. Generally speaking, Substrate primer will dry within 15 to 30 minutes when applied at 70° F or above. At 50° F, on a cloudy day, cure time may be extended to as much as one hour.
6. Check several places on primed area for dryness prior to proceeding with the flashing application.

END OF SECTION

**SECTION 05 50 00
METAL FABRICATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.
- B. Downspout boots.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 04 26 13 - Masonry Veneer: Placement of metal fabrications in masonry.
- D. Section 04 29 00 - Engineered Unit Masonry: Placement of metal fabrications in masonry.
- E. Section 05 12 00 - Structural Steel Framing: Structural steel column anchor bolts.
- F. Section 05 21 00 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
- G. Section 05 31 00 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- H. Section 05 51 00 - Metal Stairs.
- I. Section 05 51 33 - Metal Ladders.
- J. Section 07 71 23 - Manufactured Gutters and Downspouts: Downspout boots.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- I. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- J. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- K. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- L. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- M. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- N. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.

- O. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- P. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- Q. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- R. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- S. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- T. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- U. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
- V. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating; 2011 (Reapproved 2021).
- W. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- X. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- Y. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- Z. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- AA. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- BB. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- CC. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- DD. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- EE. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- FF. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- GG. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- HH. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- II. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Design under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Stainless Steel, General: ASTM A666, Type 304.
- F. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.
- G. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- H. Slotted Channel Fittings: ASTM A1011/A1011M.
- I. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- J. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- K. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- L. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- M. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- N. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Bolts, Nuts, and Washers: Stainless steel.
- F. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by intermittent welds and plastic filler.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

- F. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

- A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- C. Lintels: As detailed; prime paint finish.
- D. Sill Angles for Tempered Glass Railing Assemblies: ASTM A36/A36M steel angles with anchoring devices and sizes as indicated in shop drawings for railing assembly, drilled and tapped for fastener types, sizes, and spacing indicated, prime paint finish.
- E. Door Frames for Overhead Door Openings, Wall Openings, and _____: Channel sections; prime paint finish.
- F. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

2.05 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be embedded in concrete, items to be embedded in masonry, and items specified for _____ finish.
 - 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
- G. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- H. Stainless Steel Finish: No. 4 Bright Polished finish.

2.06 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I color anodized.
- B. Interior Aluminum Surfaces: high performance organic coating.
- C. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils thick; medium bronze.
- D. High Performance Organic Coating System: AAMA 2604 multiple coat, thermally cured fluoropolymer system; color as indicated.
- E. Fluoroethylene Vinyl Ether (FEVE) Coating: Superior performing resin based organic powder coatings system complying with AAMA 2605; single coat applications when applied to aluminum with dry film thickness (DFT) of 2 to 3 mil, 0.002 to 0.003 inch; color and gloss as scheduled.
 - 1. Apply coating to exposed metal surfaces with proper preparation and pretreatment in accordance with resin manufacturer's instructions.

2.07 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.

- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Nonstructural dimension lumber framing.
- C. Decking and Sheathing.
- D. Roof-mounted curbs.
- E. Roofing nailers.
- F. Preservative treated wood materials.
- G. Fire retardant treated wood materials.
- H. Miscellaneous framing and sheathing.
- I. Concealed wood blocking, nailers, and supports.
- J. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 05 12 00 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. PS 1 - Structural Plywood; 2023.
- D. PS 20 - American Softwood Lumber Standard; 2021.
- E. SPIB (GR) - Standard Grading Rules; 2021.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Southern Pine, unless otherwise indicated.
 - 2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER

- A. All wood is to be fire treated.
- B. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- C. Sizes: Nominal sizes as indicated on drawings, S4S.

- D. Moisture Content: S-dry or MC19.
- E. Stud Framing (2 by 2 through 2 by 6):
 - 1. Species: Southern Pine.
 - 2. Grade: No. 2.
- F. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
 - 1. Species: Southern Pine.
 - 2. Grade: No. 1 and Better.
- G. Posts:
 - 1. Species: Southern Pine.
 - 2. Grade; No. 1 & Btr.
- H. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. Oriented Strand Board: Oriented strand board wood structural panel; PS 2.
 - 1. Grade: Exterior.
 - 2. Edges: Square.
- B. Other Applications:
 - 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
 - 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
 - 3. Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

2.05 FIRE- RETARDANT- TREATED LUMBER

- A. Application: Treat all rough carpentry, unless otherwise indicated.
- B. General: Where fire- retardant- treated materials are indicated, by code, in the specifications, or Drawings, materials are to 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.
- C. Fire- Retardant- Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, 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 (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment is not to promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant- treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
 - 3. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.
- D. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.

- E. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.02 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

3.04 INSTALLATION OF CONSTRUCTION PANELS

3.05 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.06 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.07 CLEANING

- A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

**SECTION 06 16 43
GYPSUM SHEATHING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass-mat faced exterior gypsum sheathing.
- B. Fasteners and joint materials.

1.02 REFERENCES

- A. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs, 2016.
- B. ASTM C1177 - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing, 2013.
- C. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing, 2013a.
- D. GA-253 - Application of Gypsum Sheathing, 2018.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Fasteners: Materials, finish, sizes and load charts.
 - 2. Gypsum Sheathing: Gypsum sheathing, joint compound and joint tape.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- D. Qualification Documentation: Upon request, submit documentation of experience indicating compliance with specified qualification requirements.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Installer specializing in performing the work of this section with minimum five years documented experience.
- B. Manufacturer Installation Instructions: Contractor shall maintain current copy of gypsum sheathing manufacturer published installation instructions, ASTM C 1280 and GA-253 in Project Field Office and refer to installation instructions at all times during installation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Transport, handle, store, and protect Products.
- B. Deliver materials in manufacturer's unopened containers showing manufacturer's name and product brand name.
- C. Accept Products on site in manufacturer's packaging. Inspect for damage. Return damaged Products and replace with undamaged Products.
- D. Project Field Superintendent shall inspect Products immediately upon delivery to Project Site, determine Product conformance with specified requirements and reject Products not complying with specifications. Project Field Superintendent shall direct that non-complying Products be removed from Project Site immediately.
- E. Store materials inside and protected from damage. Protect ends, edges, and faces of gypsum panels from damage. Protect metal framing and accessories from bending.
- F. Store adhesives at application temperature for minimum 24 hours before application.
- G. Deliver Material Safety Data Sheet (MSDS) for each material to Project Field Superintendent for Contractor Records.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Basis-of-Design: Georgia-Pacific Building Products; DensDeck Prime with EONIC Technology Roof Boards: www.gp.com.
- B. Other Acceptable Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below.
 - 1. National Gypsum Company: www.nationalgypsum.com.
- C. Substitutions: See Section 01 60 00 - Product Requirements and Section 01 25 00 - Substitution Procedures.
 - 1. For any product not identified as "Basis of Design," submit information as specified for substitutions.

2.02 MATERIALS

- A. Fiberglass Mat Faced Gypsum Roof Board:
 - 1. Acceptable Product: GP Gypsum, DensDeck® Prime with EONIC™ Technology Roof Boards.
 - 2. Thickness: 5/8 inch.
 - 3. Width: 4 feet.
 - 4. Length: 4 feet or 8 feet.
 - 5. Weight: 2.5 lb/sq. ft.
 - 6. Surfacing: Primed Fiberglass Mat.
 - 7. Flexural Strength, Parallel (ASTM C473): 100 lbf, minimum.
 - 8. Flute Span (ASTM E661): 8 inches.
 - 9. Permeance (ASTM E96): Greater than 17 perms.
 - 10. R-Value (ASTM C518): 0.67.
 - 11. Water Absorption (ASTM C473): Less than 5 percent of weight.
 - 12. Surface Water Absorption (ASTM C473): Nominal 1.0 grams.
 - 13. Compressive Strength (Applicable Sections of ASTM C472): Nominal 900 pounds per square inch.
 - 14. Flame Spread/ Smoke Development (ASTM E84): Not more than 0 Flame Spread, 0 Smoke Development
 - 15. Combustibility (ASTM E136): Noncombustible
 - 16. Fire resistance rating (UL 790 and ASTM E108): Class A
 - 17. Mold Resistance (ASTM D3273): Scored a 10
- B. Joint Tape: 2 inch wide 10 x10 glass mesh tape, recommended by manufacturer.
- C. Joint Compound: Setting-type compound, recommended by manufacturer.
- D. Fasteners to Framing: ASTM C1002; steel bugle head, self-tapping corrosion resistant.
- E. Sealant: Type recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. See Section 01 70 00 - Execution and Closeout Requirements for verification of existing conditions before starting.
- B. Verify that surface of framing to receive sheathing does not vary more than 1/4 inch from placement of faces of adjacent members.
- C. Report in writing to Architect 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.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.02 PREPARATION

- A. Coordinate installation of bucks, anchors, blocking, electrical and mechanical work installed in or behind framing. Allow items to be installed after framing is complete.

3.03 INSTALLATION

- A. Apply only as many roof boards as can be covered by a roof membrane system in the same day.
- B. Comply with ASTM C1280, GA-253 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- C. Board edges and ends shall be butted tightly together; do not gap edges or ends.
- D. Joint Treatment:
 - 1. Method No. 1:
 - a. Apply minimum 3/8 inch bead of sealant to all joints and trowel to provide a layer approximately 2 inches wide by 1/16 inch thick spanning the joint.
 - b. Use backer rod for openings larger than 1/8 inch.
 - 2. Method No. 2:
 - a. Apply glass mesh joint tape to all joints, overlapping intersections by width of tape.
 - b. Apply approximately 3/8 inch bead of sealant along joint. Embed sealant into entire surface of tape with trowel.
 - c. Apply enough sealant to each exposed fastener to cover completely when troweled flat.
 - d. Use backer rod for openings larger than 1/8 inch.
- E. Seal all penetrations watertight with sealant specified for Joint Treatment Method selected.

3.04 TOLERANCES

- A. Maximum Variation of Finished Sheathing Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.05 FIELD QUALITY CONTROL

- A. Section 01 4000 - Quality Requirements: Contractor Quality Control Representative shall perform contractor quality control inspections.
 - 1. Document preparatory, initial and follow-up inspection in Contractor's Test and Inspection Reports.
 - 2. Test and Inspection Reports shall be available to Architect upon request.
- B. Inspect gypsum sheathing board installation, board types and thicknesses.
- C. Inspect and verify number, type and spacing of fasteners.
- D. Inspect joint treatment, sealing and taping.
- E. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.

3.06 PROTECTION

- A. Protect roof board installations from damage and deterioration until the date of Substantial Completion.

END OF SECTION

**SECTION 07 21 00
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at perimeter foundation wall, underside of floor slabs, over roof deck, and exterior wall behind metal panel wall finish.
- B. Batt insulation in exterior wall and ceiling construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.
- B. Section 07 54 00 - Thermoplastic Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- D. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
- E. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- G. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emisometers; 2015 (Reapproved 2022).
- H. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- K. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C; 2022.
- L. ICC-ES AC239 - Acceptance Criteria for Termite-Resistant Foam Plastic; 2008, with Editorial Revision (2022).
- M. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation Over Roof Deck: Extruded polystyrene (XPS) board.
- D. Insulation on Outside face of masonry walls: Extruded polystyrene (XPS) continuous insulation (CI) carbon black board

2.02 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
 - 5. Board Edges: Square.
 - 6. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
 - 7. Products:
 - a. DuPont de Nemours, Inc; Styrofoam Brand _____: building.dupont.com/#sle.
 - b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Complies with ASTM C578, and manufactured using carbon black technology.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Type and Thermal Resistance, R-value: Type IV, 5.6 (0.98), minimum, per 1 inch thickness at 75 degrees F mean temperature.
 - 4. Board Size: 48 inch by 96 inch.
 - 5. Board Thickness: 1-3/4 inch.
 - 6. Board Edges: Shiplap, at long edges.
 - 7. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
- C. Rigid Thermoset Board Insulation: Fiber-free phenolic insulation with zero Ozone Depletion Potential (ODP) blowing agent and faced on both sides with low emissivity composite foil.
 - 1. Flame Spread Index (FSI): Class B - 26 to 75, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Width, Nominal: 47-1/4 inch.
 - 4. Board Length, Nominal: 16 inch.
 - 5. Board Thickness, Nominal: 1-3/16 inch.
 - 6. Board Edges: Square.
 - 7. Water Absorption: 1.2 percent by volume, maximum.
 - 8. Compressive Strength: 15 psi (104 kPa), minimum.
 - 9. Thermal Resistance: R-value of 8.05, minimum, per inch at 75 degrees F, minimum, when tested according to ASTM C518.

2.03 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 4. Formaldehyde Content: Zero.
 - 5. Products:
 - a. CertainTeed Corporation; _____: www.certainteed.com/#sle.
 - b. Johns Manville; _____: www.jm.com/#sle.
 - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 3. Products:
 - a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
 - b. Thermafiber, Inc; SAFB: www.thermafiber.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

- A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
 - 1. Application: Sealing of interior circular penetrations, such as pipes or cables.
 - 2. Width: As required for application.
- B. Self-Adhered Transition Flashing: Multipurpose, self-adhered flashing with modified butyl adhesive, polyester fiber top sheet, and polypropylene interlayer.
 - 1. Application: Primerless adhesion for use as through-wall flashings and wall transitions to roof and below-grade systems.
 - 2. Thickness: 45 mil, 0.045 inch, nominal.
 - 3. Size: 6 inches wide, in rolls 75 feet long.
- C. Flashing Tape: Special reinforced film with high performance adhesive.
 - 1. Application: Window and door opening flashing tape.
 - 2. Width: As required for application.
- D. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
 - 1. Width: 3-1/2 inches.
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
- E. Insulation Fasteners: Lengths of unfinished, 13 gauge, 0.072 inch high carbon spring steel with chisel or mitered tips, held in place by tension, length to suit insulation thickness and substrate, capable of securely supporting insulation in place.
- F. Continuous Insulation (CI) Support Clips: Thermally-broken, with thermal spacer clip or steel support clip with thermal isolator pad for support of cladding z-girts, angles, channels, and other insulation framing.
 - 1. Thermal Spacer Clip: Pultruded glass fiber and thermoset polyester resin clip; 3/16 inch thick at top, base, and web.

2. Galvanized Steel Support Clip: 14 gauge, 0.0747 inch, G90/Z275 galvanized support clip complying with ASTM A653/A653M, with integral glass fiber reinforced polyamide thermal isolator pad.
3. Clip Depth: As indicated on drawings.
4. Products:
 - a. Cascadia Windows & Doors; Cascadia Clip: www.cascadiawindows.com/#sle.
 - b. Northern Facades; ISO Clip: www.northernfacades.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Adhere a 6 inches wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
 1. Tape seal joints.
 2. Extend sheet full height of joint.
- B. Apply adhesive to back of boards:
- C. Install boards horizontally on foundation perimeter.
 1. Place boards to maximize adhesive contact.
 2. Install in running bond pattern.
 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- D. Extend boards over expansion joints, unbonded to foundation on one side of joint.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Install boards horizontally on walls.
 1. Place boards to maximize adhesive contact.
 2. Install in running bond pattern.
 3. Butt edges and ends tightly to adjacent boards and protrusions.
- B. Extend boards over expansion joints, unbonded to wall on one side of joint.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BOARD INSTALLATION USING COMPOSITE FRAMING SUPPORT (CFS) SYSTEM

- A. Install CFS system in accordance with manufacturer's installation instructions.
- B. Install CFS system in compliance with system orientation, sizes, and locations as indicated on drawings.
- C. Install CFS system to fill-in exterior wall spaces without gaps or voids, and do not compress insulation boards.
- D. Trim insulation neatly to fit spaces, and insulate miscellaneous gaps and voids with approved expandable foam sealant.

3.05 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.06 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.08 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

**SECTION 07 25 10
RUBBERIZED ASPHALT FLASHING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rubberized asphalt self-adhering sheet membrane.

1.02 RELATED REQUIREMENTS

- A. Section 06 1643 - Gypsum Sheathing
- B. Section 07 2500 - Weather Barriers

1.03 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
- B. ASTM D461 - Standard Test Methods for Felt.
- C. ASTM D 903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
- D. ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- E. ASTM D3767 - Standard Practice for Rubber-Measurement of Dimensions.
- F. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on membrane and physical properties.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Protect from damage.
- B. Cover materials and store in dry condition between temperatures of 40 and 90 degrees F. Use within one year of date of manufacture.
- C. Do not store at elevated temperatures as that will reduce the shelf life of the product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: GCP Applied Technologies; Grace Ice and Water Shield: www.gcpat.com.
- B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Description: Cold applied, self-adhering membrane composed of high strength polyethylene film coated on one side with layer of rubberized asphalt adhesive and inter-wound with disposable release sheet. Embossed, slip-resistant surface provided on polyethylene.
- B. Color: Gray-black.
- C. Membrane Thickness: 40 mil, ASTM D3767 procedure A (Section 9.1).
- D. Tensile Strength, Membrane: 250 psi, ASTM D412 (Die C modified).
- E. Elongation, Membrane: 250 percent, ASTM D412 (Die C modified).
- F. Low Temperature Flexibility: Unaffected @ -20 degrees F ASTM D1970.
- G. Adhesion to Plywood: 3.0 pounds per inch width, ASTM D903.
- H. Permeance (Max): 0.05 Perms, ASTM E96.
- I. Material Weight Installed (Max): 0.3 pounds per square foot, ASTM D461.
- J. Primer: As recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces, substrates and conditions are as required and ready to receive work.
- B. Inspect to verify weather barrier is in place and substrate is clean and dry.

3.02 INSTALLATION

- A. Install membrane on clean, dry and continuous substrate. Fill voids and damaged or unsupported areas before installation.
- B. Unroll membrane and cut into sheets of width and length required to completely cover window sill area as detailed.
- C. Peel release film and center sheet on window opening at sill. Drape and press sheet into place, working from the center of window sill outward in each direction.
- D. Install membrane continuous over wood blocking under window sill receiver and down wall over weather barrier minimum 4 inches, where indicated on drawings.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for contractor field quality control requirements.
- B. Inspect membrane installation, type and adherence to substrate.
- C. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.

END OF SECTION

**SECTION 07 54 23
THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING - CARLISLE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Adhered system with thermoplastic polyolefin (TPO) roofing membrane.
- B. Insulation, flat and tapered.
- C. Deck sheathing.
- D. Flashings.
- E. Roofing cant strips, stack boots, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers and curbs.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings.
- C. Section 07 72 00 - Roof Accessories: Roof-mounted units; prefabricated curbs.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
- D. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
- E. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.
- F. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011 (Reapproved 2019).
- G. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2022).
- H. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2022).
- I. NRCA (RM) - The NRCA Roofing Manual; 2024.
- J. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's written information listed below.
 - 1. Product data indicating membrane materials, flashing materials, insulation, surfacing, and fasteners.
 - 2. Preparation instructions and recommendations.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- E. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- F. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- G. Warranty:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section:
 - 1. With minimum five (5) years documented experience.
 - 2. Approved by membrane manufacturer.
- C. Single Source Responsibility: Provide and install products from a single source.

1.07 MOCK-UP

- A. Provide mock-up for evaluation of surface preparation, installation methods, and workmanship. mock-up.
- B. See Section 01 40 00 - Quality Requirements for additional requirements.
- C. Mock-up may not remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Protect products in weather protected environment, clear of ground and moisture.
- C. Protect foam insulation from direct exposure to sunlight.
- D. Provide Safety Data Sheets (SDS) at the project site at all times during transportation, storage, and installation of materials.
- E. Comply with requirements from Owner to prevent overloading or disturbance of the structure when loading materials onto the roof.

1.09 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather. Refer to manufacturer's written instructions.
- B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- D. Proceed with work so new roofing materials are not subject to construction traffic as work progresses.
- E. Do not allow grease, oil, fats, or other contaminants to come into direct contact with membrane.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
 - 1. Warranty Term: 20 years. No Dollar Limit.
 - 2. For repair and replacement include costs of both material and labor in warranty.
 - 3. Include accidental punctures according to the manufacturer's standard warranty terms.

4. Include hail damage according to the manufacturer's standard warranty terms.
- C. Provide warranty signed both jointly and severally by the installer and the manufacturer. The warranty shall be in writing addressed to the Oklahoma City Zoo Trust and transmitted to the Architect prior to final acceptance of work. Roof will not be considered over 90% complete until a satisfactory warranty has been received and approved by the Architect.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. BASIS OF DESIGN: Carlisle SynTec: www.carlisle-syntec.com/#sle.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ROOFING APPLICATIONS

- A. TPO Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Roofing Assembly Performance Requirements and Design Criteria:
 1. Solar Reflectance Index (SRI): Minimum of 64 based on three-year aged value; if three-year aged data is not available, minimum of 82 initial value.
 - a. Calculate SRI in accordance with ASTM E1980.
 - b. Field applied coating may not be used to achieve specified SRI.
 2. Roof Covering External Fire Resistance Classification: Class A when tested per UL 790.
 3. Wind Uplift:
 - a. Designed to withstand wind uplift forces calculated with ASCE 7.
 4. Insulation Thermal Resistance (R-Value): Provide R-30, minimum, over entire roof deck.
 5. Drainage: No standing water within 48 hours after precipitation.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Single Source Responsibility: Provide and install products from single source.
- B. Membrane:
 1. Material: Thermoplastic Polyolefin (TPO) complying with ASTM D6878/D6878M.
 2. Reinforcing: Internal fabric.
 3. Thickness: 60 mils (0.060 inch), minimum.
 4. Sheet Width: Factory fabricated into largest sheets possible.
 5. Color: White.
 6. Product:
 - a. Carlisle Sure-Weld.
- C. Seaming Materials: As recommended by membrane manufacturer.
- D. Flexible Flashing Material: Same material as membrane.
- E. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.04 DECK SHEATHING AND COVER BOARDS

- A. Deck Sheathing and Cover Board: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/4 inch thick.
 1. Product: GP Dens-Deck Prime, distributed by Carlisle.
- B. Coverboard: Cement roof board, complying with ASTM C1325.
 1. Board Thickness: 1/2 inch.

2.05 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: ASTM C1289, Type II, Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of the core foam.
 1. Grade and Compressive Strength: Grade 2, 20 psi, minimum.
 2. Product:
 - a. Carlisle HP-H.

2.06 ACCESSORIES

- A. Prefabricated Flashing Accessories:
 - 1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
 - 2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
 - 3. Sealant Pockets: Same material as membrane, with manufacturer's standard accessories, in manufacturer's standard configuration.
 - 4. Pressure Sensitive Cover Strips: 6 inch wide, 45 mils (0.045 inch) thick, non-reinforced TPO membrane laminated to 35 mils (0.035 inch) thick cured synthetic rubber with pressure sensitive adhesive.
 - 5. TPO Pressure Sensitive RUSS:
 - a. 6 inch wide, 40 mils (0.040 inch) thick, reinforced TPO membrane with 3 inch wide, 35 mils (0.035 inch) thick cured synthetic rubber with pressure sensitive adhesive laminated to one edge.
 - 6. Walkway Rolls: Sure-Flex Heat Weldable Walkway Rolls; 80 mils (0.080 inch) thick; gray membrane.
 - 7. Miscellaneous Flashing: Non-reinforced TPO membrane; 80 mils (0.080 inch) thick, in manufacturer's standard lengths and widths.
 - 8. Setting pipes 3" in diameter greater: Provide prefabricated curbs and pipe stands.
 - 9. Setting rooftop equipment: Provide prefabricated metal flashed curbs. Lumber is NOT acceptable.
- B. Insulation Adhesive: Two component polyurethane, expanding foam .
- C. Insulation Fasteners: Appropriate for purpose intended and approved by Factory Mutual and roofing manufacturer.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- D. Membrane Adhesive: As recommended by membrane manufacturer.
- E. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- F. Sealants: As recommended by membrane manufacturer.
- G. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.
- H. Edgings and Terminations: Manufacturer's standard edge and termination accessories.
 - 1. TPO Coated Sheet Metal.
 - 2. Termination Bar.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION, GENERAL

- A. Clean substrate thoroughly prior to roof application.
- B. Do not begin work until other work that requires foot or equipment traffic on roof is complete.

3.03 INSTALLATION - GENERAL

- A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- F. Coordinate the work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.04 INSULATION APPLICATION

- A. Attachment of Insulation:
 - 1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
 - 2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
- B. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.
- C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- D. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- E. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
- F. Do not apply more insulation than can be completely waterproofed in the same day.

3.05 MEMBRANE APPLICATION

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive at manufacturer's recommended rate. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Seam Welding:
 - 1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches.
 - 2. Cover seams with manufacturer's recommended joint covers.
 - 3. Probe seams once welds have thoroughly cooled. (Approximately 30 minutes.)
 - 4. Repair deficient seams within the same day.
 - 5. Seal cut edges of reinforced membrane after seam probe is complete.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Coordinate installation of roof drains and sumps and related flashings. Locate all field splices away from low areas and roof drains. Lap upslope sheet over downslope sheet.
- G. Install walkway pads at areas of concentrated traffic and as shown on Drawings. Space pad joints to permit drainage.
- H. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field quality control and inspection.
- B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

3.07 CLEANING

- A. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.
- B. Remove bituminous markings from finished surfaces.
- C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- D. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

**SECTION 07 62 00
SHEET METAL FLASHING AND TRIM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, sheet metal roofing, exterior penetrations, _____, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

- A. Section 04 20 00 - Unit Masonry: Metal flashings embedded in masonry.
- B. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking for batten seams.
- D. Section 06 10 00 - Rough Carpentry: Field fabricated roof curbs.
- E. Section 07 71 00 - Roof Specialties: Manufactured copings, flashings, and expansion joint covers.

1.03 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- E. ASTM B32 - Standard Specification for Solder Metal; 2020.
- F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- H. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- I. CDA A4050 - Copper in Architecture - Handbook; current edition.
- J. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sheet Metal Flashing and Trim Manufacturers:
 - 1. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.
 - 2. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
 - 3. Tamlyn: www.tamlyn.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Exterior Penetration Flashing Panel Manufacturers:
 - 1. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SHEET MATERIALS

- A. Pre-Finished Aluminum: ASTM B209/B209M; 18 gauge, 0.040 inch thick; plain finish shop pre-coated with silicone modified polyester coating.
 - 1. Silicone Modified Polyester Coating: Pigmented organic powder coating, AAMA 2603; baked enamel finish system.
 - 2. Fluoroethylene Vinyl Ether (FEVE) Coating: Superior performing organic powder coating, AAMA 2605; base coat with clear top coat of FEVE coatings.
 - 3. Color: As selected by Architect from manufacturer's full range of colors.
- B. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch thick; smooth No. 4 - Brushed finish.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.04 EXTERIOR PENETRATION FLASHING PANELS

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.05 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Fenestration Perimeter Flashing Attachments: Two-piece flashing receiver and clip of extruded aluminum, at least 0.045 inch thick, for attaching flashing at perimeter of exterior wall fenestration openings.

1. Provide flashing receiver profile appropriate for flashing applications.
- F. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.
- G. Reglets: Surface-mounted type, galvanized steel; face and ends covered with plastic tape.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction, and as follows:

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

**SECTION 07 92 00
JOINT SEALANTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Acoustical joint sealants.
- D. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Setting exterior door thresholds in sealant.
- B. Section 08 80 00 - Glazing: Glazing sealants and accessories.
- C. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- D. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- E. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
- F. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. See Section 01 31 00 - Project Management and Coordination, for project coordination requirements.
- B. Coordination: Coordinate installation of joint sealants with cleaning of joint sealant substrates and other operations that may impact installation or finished joint sealant work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data for Sealants and Acoustical Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Substrates for which laboratory adhesion and/or compatibility testing is required.
 - 7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - 8. Sample product warranty.
 - 9. Certification by manufacturer indicating that product complies with specification requirements.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Acoustic Sealant Installation Details: Submit specific installation details for the following in STC rated wall assemblies:
- F. Installation Plan: Submit at least four weeks prior to start of installation.
- G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- H. Installation Log: Submit filled out log for each length or instance of sealant installed.
- I. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.
- J. Manufacturer Warranty: Submit Manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with Manufacturer.
- K. Installer Warranty: Submit warranty statement on Installer's letterhead.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience.
- C. Installation Plan: Include schedule of sealed joints, including the following.
 - 1. Joint width indicated in Contract Documents.
 - 2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
 - 3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgement that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
 - 4. Approximate date of installation, for evaluation of thermal movement influence.
 - 5. Installation Log Form: Include the following data fields, with known information filled out.
 - a. Unique identification of each length or instance of sealant installed.
 - b. Location on project.
 - c. Substrates.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Primer to be used, or indicate as "No primer" used.
 - g. Size and actual backing material used.
 - h. Date of installation.
 - i. Name of installer.
 - j. Actual joint width; provide space to indicate maximum and minimum width.
 - k. Actual joint depth to face of backing material at centerline of joint.
 - l. Air temperature.
- D. Field Quality Control Plan:
 - 1. Visual inspection of entire length of sealant joints.
 - 2. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Section 01 6000 - Product Requirements: Transport, handle, store and protect Products.
- B. Deliver materials in unopened manufacturers' sealed shipping containers with brand name, date of manufacture, color and material designation clearly marked.
- C. Label containers to identify type, class, grade and use.

- D. Keep materials and containers closed and separated from absorptive materials.
- E. Project Field Superintendent shall inspect Products immediately upon delivery to Project Site, determine Product conformance with specified requirements and reject Products not complying with specifications. Project Field Superintendent shall direct that non-complying Products be removed from Project Site immediately.
- F. Deliver Material Safety Data Sheet (MSDS) for each material to Project Field Superintendent for Contractor Records.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Manufacturer Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
- D. Installer Warranty: Installer agrees to repair or replace joint sealants that deteriorate or fail within a two year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Dow Chemical Company: www.dowcorning.com.
- B. Pecora Corporation: www.pecora.com.
- C. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
- D. Substitutions: See Section 01 6000 - Product Requirements and Section 01 2500 - Substitution Procedures.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 - 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In STC sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
 - 1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
 - 2. Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
 2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
 3. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
 4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 6. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
 7. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- D. Interior Wet Areas: restrooms; fixtures in wet areas include plumbing fixtures and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.03 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: 50 percent, minimum.
 2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Service Temperature Range: Minus 20 to 180 degrees F.
 5. Manufacturers:
 - a. Dow; DOWSIL 756 SMS Building Sealant: www.dow.com/#sle.
 - b. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
 - c. Pecora Corporation; 890NST Ultra Low Modulus Architectural Silicone Sealant - Class 100: www.pecora.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.
 2. Manufacturers:
- C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus ____ percent, minimum.
- D. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface .
1. Movement Capability: Plus and minus 35 percent, minimum.
- E. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
 2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
 3. Manufacturers:
 - a. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

2.04 SELF-LEVELING SEALANTS

- A. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
1. Movement Capability: Plus and minus 25 percent, minimum.

- B. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 - 1. Composition: Multi-component, 100 percent solids by weight.
 - 2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
 - 3. Joint Width, Minimum: 1/8 inch.

2.05 ACOUSTICAL JOINT SEALANTS

- A. Acoustical sealants shall have the following properties:
 - 1. Hardness of no more than 50 durometer Shore A as rated in ASTM D2240.
 - 2. Minimum elongation of 500% as rated in ASTM D412.
 - 3. Minimum joint width movement of 25% as rated in ASTM C719.
 - 4. Self Leveling type (S/L) if applied on floors in accordance with ASTM C639.
 - 5. Non-Sag type (N/S) if applied on walls in accordance with ASTM C639.
 - 6. Acoustical sealants must meet the following additional requirements where applied in exposed locations:
 - a. Acoustical sealants shall be paintable.
 - b. Acoustical sealants shall be skinning type.
 - c. Acoustical sealants shall be non-staining type as rated in ASTM C510.
- B. For concealed locations, acoustical sealants shall be one of the following approved products. Substitutions are unacceptable unless otherwise approved by the Architect and project Acoustics Consultant.
 - 1. Tremco Acoustical Sealant
 - 2. GE SilPruf SCS2000
 - 3. PTI Architectural Sealant 707
- C. For exposed locations, acoustical sealants shall be one of the following approved products. Substitutions are unacceptable unless otherwise approved by the Architect and project Acoustics Consultant.
 - 1. DAP Dynaflex 230
 - 2. GE SCS7000
 - 3. Sikaflex 1a
- D. For fire-rated locations, acoustical sealants shall be one of the following approved products. Substitutions are unacceptable unless otherwise approved by the Architect and project Acoustics Consultant.
 - 1. HILTI CP 601S
 - 2. STI Spec Seal PEN300
 - 3. Tremco Fyre-Sil
 - 4. Johns Manville Firetemp CI

2.06 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B. Neoprene Filler:
- C. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- D. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- E. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- F. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01700 - Execution Requirements: Verification of existing conditions before starting work.
- B. Verify that joints are ready to receive work.
- C. Verify that backing materials are compatible with sealants.
- D. Verify that backer rods are of the correct size.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Control: Contractor Quality Control Representative shall perform contractor quality control inspections.
 - 1. Document preparatory, initial and follow-up inspection in Contractor's Test and Inspection Reports.
 - 2. Test and Inspection Reports shall be available to Architect upon request.
- B. Inspect each joint, joint preparation, sealant type, installation and adhesion of joint sealer and backing.
- C. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- E. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.

END OF SECTION

**SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior aluminum-framed storefront, with vision glass integrated with glazed aluminum curtain walls.
- B. Aluminum doors and frames.
- C. Weatherstripping.
- D. Door hardware.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 08 4314 - Interior Aluminum-Framed Storefronts: Interior storefront system.
- C. Section 08 44 13 - Glazed Aluminum Curtain Walls. Entrance doors in curtain wall system.
- D. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- E. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 501.4 - Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.
- D. AAMA 501.5 - Test Method for Thermal Cycling of Exterior Walls; 2007.
- E. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- F. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- G. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- H. AAMA 1304 - Voluntary Specification for Forced Entry Resistance of Side-Hinged Door Systems; 2002.
- I. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- J. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- K. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- M. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- N. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- O. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

- P. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
- Q. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).
- R. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. See Section 01 31 00 - Project Management and Coordination, for project coordination requirements.
- B. Coordinate with installation of other components that comprise the exterior enclosure.
- C. Door Hardware Coordination: Storefront entrance door installer shall meet with Contractor Project Field Superintendent to coordinate timing and schedule for storefront door installer receipt of storefront door hardware.
 - 1. Contractor Project Field Superintendent shall provide storefront door hardware to storefront door hardware installer with hardware for each door packaged and labeled with hardware set number and door number hardware will be installed on.
- D. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.
 - 1. Review conditions of operations, procedures and coordination with related Work.
 - 2. Agenda:
 - a. Tour, inspect and discuss conditions at openings where storefront system will be installed and other preparatory work performed by other trades.
 - b. Review storefront system requirements (Drawings, Specifications and other Contract Documents).
 - c. Review required submittals, both completed and yet to be completed.
 - d. Review storefront system Shop Drawings.
 - e. Review and finalize construction schedule related to storefront system work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - f. Review requirements for Manufacturer's Quality Control Inspector inspections and operational tests.
 - g. Review safety precautions relating to installation of storefront system.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
 - 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Samples: Submit three samples 12 by 12 inches in size illustrating finished aluminum surface.
- E. Test Report: Results of entrance door structural corner weld strength test per Kawneer dual moment load test procedure and certification by an independent testing laboratory to ensure weld compliance and corner integrity.
- F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- G. Design Data: Design calculations, identify dimensional limitations; include load calculations at points of attachment to building structure, bearing seal and signature of Professional Structural Engineer licensed to practice in the State in which the Project is located, documenting compliance of exterior assemblies with wind pressure criteria.

- H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- I. Designer's Qualification Statement.
- J. Installer's Qualification Statement.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer as follows:
 - 1. Material and Workmanship.
 - 2. Welded Door Corner.
 - 3. Finish.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure. This is to be under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
 - 1. The storefront system should be designed to meet the wind loads noted on Structural sheets, and all dimensions on the Drawings.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- D. Source Limitations: Obtain glazed aluminum-framed storefront and glazed aluminum curtainwall system through one source from a single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Material and Workmanship: Correct defective Work within a five year period after Date of Substantial Completion.
- C. Welded Door Construction: Provide limited lifetime warranty for life of the door for welded door corners of storefront swinging doors.
- D. Finish: Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Kawneer North America: www.kawneer.com/#sle..
 - 1. Storefront System 1: Trifab VersaGlaze 601 or 601T, center set, provide where shown.
 - a. 2- inch x 4- 1/2- inch nominal dimension.
 - b. Thermally broken.
 - 1) Exterior storefront is to be thermally broken.
 - 2) Interior storefront is not required to be thermally broken.
 - 2. Storefront System 2: Trifab VersaGlaze 451 or 451T, center set, provide where shown.
 - a. 2- inch x 6- inch nominal dimension.
 - b. Thermally Broken.

- 1) Exterior storefront is to be thermally broken.
 - 2) Interior storefront is not required to be thermally broken.
- B. Other Acceptable - Aluminum-Framed Storefronts Manufacturers: Subject to compliance with requirements, provide Basis of Design or comparable product by one of the following:
1. Oldcastle BuildingEnvelope: www.oldcastlebe.com/#sle.
 2. Tubelite, Inc: www.tubeliteinc.com/#sle.

2.02 STOREFRONT SYSTEM

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Unitized, shop assembly.
 2. Glazing Rabbet: For 1 inch insulating glazing.
 3. Glazing Position: Centered (front to back).
 4. Finish: Class I color anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 5. Finish Color: Match existing.
 6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 12. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and heel bead of glazing compound.

2.03 PERFORMANCE REQUIREMENTS

- A. General Requirements
1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of aluminum storefront systems representing those indicated for this project.
 2. Aluminum storefront systems 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.
 3. Failure includes any of these events:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage .
 - c. Loosening or weakening of fasteners, attachments, and other components.
 - d. Failure of operating units.
- B. Delegated Design:
1. Design aluminum storefront systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- C. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - 1. Design Wind Loads: Comply with requirements of ASCE 7 and Wind Load Design Criteria indicated on Structural Drawing entitled "General Notes."
 - 2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- D. Air Leakage Laboratory Test:
 - 1. The test specimen shall be tested in accordance with ASTM E 283.
 - 2. With interior seal, air leakage rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa).
 - 3. Without interior seal, air leakage rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 1.6 psf (75 Pa).
 - 4. CSA A440 Fixed Rating.
- E. Water Resistance:
 - 1. The test specimen shall be tested in accordance with ASTM E 331.
 - 2. There shall be no leakage at a minimum static air pressure differential of 10 psf (479 Pa) as defined in AAMA 501.
 - 3. CSA A440 B5 Rating.
- F. Uniform Load:
 - 1. A static air design load of 30 psf (1436 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330.
 - 2. There shall be no deflection in excess of L/175 of the span of any framing member.
 - 3. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
 - 4. CSA A440 C2 Rating.
- G. Seismic: When tested to AAMA 501.4, system must meet design displacement of 0.010 by the story height and ultimate displacement of 1.5 by the design displacement.
- H. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures.
 - 1. Temperature Change (Range): 0 deg F; 180 deg F.
 - 2. Test Interior Ambient-Air Temperature: 75 deg F.
 - 3. Test Performance: 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 for minimum 3 cycles.
- I. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.04 STOREFRONT ENTRANCE DOORS AND HARDWARE

- A. Aluminum -Framed Storefront Entrance Doors: Factory fabricated, factory finished aluminum framing members, hardware, anchorage and attachment devices.
 - 1. Product:
 - a. Exterior Pair: Kawneer, 500 Standard Entrance.
 - b. Interior Pair: Kawneer, 500 Standard Entrance.
 - 2. Finish: As specified for storefront system.
 - 3. Unitized shop assembly.
 - 4. Door corner construction of mechanical clip fastening, SIGMA 1-1/8 inch long fillet welds along top and bottom of rail extrusion at stile and rail intersection and deep penetration plug weld at all four corners of door.
 - a. Welding shall be full penetration plug weld to leg of clip, 1-1/8 inch long top and bottom of rails at stiles intersection.
 - b. Tie-rod construction or any type or partial design not permitted.
 - c. Dual moment testing of corner required.

5. Doors and hardware shall conform to requirements of ANSI A117.1 and ADA.
- B. Performance Requirements:
 1. Wind, Water and Air: Meet wind, water and air requirements as specified for storefront system.
 2. Structural Performance: Corner strength shall be tested per Kawneer dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity.
 3. Forced Entry Resistance: Comply with AAMA 1304.
- C. Door Types:
 1. Single acting.
 2. Exterior Pair: Dual glazed aluminum.
 3. Interior Pair: Single glazed aluminum.
- D. Door Description:
 1. Thickness: 2 inches
 2. Top Rail: 5- inches wide.
 3. Vertical Stiles: 5- inches wide.
 4. Bottom Rail: 12- inches wide.
 5. Glazing Stops: Square.
- E. Exterior Storefront Entrance Door Weatherstripping: Furnished and installed by storefront system supplier.
 1. Meeting stiles on pair of doors shall be equipped with adjustable astragal utilizing wool pile with polymeric fin.
 2. Door weathering on a single acting door and frame (single or pairs) comprised of thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.
- F. Storefront Entrance Door Hardware:
 1. Refer to Division 08 Section Door Hardware.

2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
 1. Provide stiffening as needed to meet the noted heights and wind requirements.
 2. Framing members for interior applications need not be thermally broken.
 3. Glazing Stops: Flush.
 4. Cross-Section: As noted above
 5. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 6. Sill Receptor (Sill Flashing): Continuous extruded sill with metal end dams of same material and dimension as sill receptor. Back leg of sill receptor minimum 1-1/2 inches.
- B. Glazing: See Section 08 80 00.

2.06 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Fasteners: Stainless steel.
- D. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- E. Concealed Flashings: Galvanized steel, 26 gauge, 0.0179 inch minimum base metal thickness.
- F. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- G. Sealant for Setting Thresholds: Non-curing butyl type.
- H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

- I. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.07 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils thick.
- B. Color: Match existing.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.08 DOOR HARDWARE

- A. For each door, include weatherstripping.
- B. Other Door Hardware: See Section 08 71 00.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, operational clearances, and method of attachment with other work.
- B. Verify openings are sized to receive storefront system and sill is level in accordance with manufacturer acceptable tolerances.
- C. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.
- D. Proceed with installation only after correcting unsatisfactory conditions.
 - 1. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.02 INSTALLATION

- A. Install storefront and entrance system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.
- G. Install sill flashings, sill receptor, end dams and other members in bed of sealant to provide weathertight construction. Turn up ends and edges; seal to adjacent work to form water tight dam.
- H. Install components to drain water passing joints and condensation and moisture occurring or migrating within storefront system to exterior.
- I. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- J. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- K. Install intersection and joint sealant at framing member joints, intersections and covering sill receptor anchors at locations indicated in manufacturer's published installation instructions.
- L. Install additional flashing under sill receptor in bed of sealant where indicated on Drawings.
- M. Install storefront doors and hardware in accordance with manufacturer's instructions, ANSI/ICC A117.1 and ADA requirements.

- N. Install glass in accordance with Section 08 8800 - Glazing, using glazing method required to achieve performance criteria.
- O. Install perimeter sealant in accordance with Section 07 9000 - Joint Sealants.
- P. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- Q. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 400 0 - Quality Requirements, for contractor quality control requirements.
- B. Inspect storefront entrance system installation, flashing, attachment to building structure, and continuity of weather barrier assembly.
- C. Inspect glass installation, sealant and finish.
- D. Manufacturer's Field Services: Manufacturer's Quality Control Inspector.
 - 1. Perform initial and final inspections.
 - 2. Prepare and submit inspection reports for each inspection made.
- E. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.
- F. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- G. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as directed by Architect.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 - 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
 - a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
 - 4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf.
 - a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft.
 - 5. Field testing is to be the responsibility of the installer.
- H. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.
 - 1. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.
 - 2. Retesting, and paying for the retesting, is to also be the responsibility of the installer.

3.05 ADJUSTING

- A. Adjust operating hardware for smooth operation.
 - 1. Comply with all applicable accessibility requirements.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Just before Substantial Completion Inspection, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

- A. Remove and replace glass that has been broken, chipped, cracked, abraded or damaged during construction.
- B. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

**SECTION 08 44 13
GLAZED ALUMINUM CURTAIN WALLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.

1.02 RELATED REQUIREMENTS

- A. Section 08 43 13 - Aluminum-Framed Storefronts: Entrance framing and doors.
- B. Section 08 80 00 - Glazing.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- C. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing and infill.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
- F. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
- G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- H. Designer's Qualification Statement.
- I. Manufacturer's Qualification Statement.
- J. Installer's Qualification Statement.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design curtain wall and its structural support framing components by a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
 1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Kawneer North America; Model .

2.02 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Finish: Class I natural anodized.
 - a. Factory finish surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 2. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
 1. Design Wind Loads: Comply with the following:
 - a. Positive Design Wind Load: ____ lbf/sq ft.
 - b. Negative Design Wind Load: ____ lbf/sq ft.
 - c. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
 2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Expansion and contraction caused by 180 degrees F surface temperature.

- b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
- 1. Test Pressure Differential: 10 psf.
- D. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.27 psf pressure difference across assembly.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
- B. Glazing: See Section 08 80 00.

END OF SECTION

**SECTION 08 71 13
AUTOMATIC DOOR OPERATORS**

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Exterior and interior, automatic door operators, low energy, with visible header mounting.
- B. Automatic door operators shall be configured for doors as follows:
 - 1. Simultaneous pairs, same swing.

1.02 RELATED REQUIREMENTS

- A. Section 01 25 00 -Substitution Procedure: Administrative and procedural requirements for requesting approval of substitution.
- B. Section 01 30 00 – Administrative Requirements: Requirements for submittal procedures, project meetings, progress schedules, and documentation, reports, and coordination.
- C. Section 01 60 00 – Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
- D. Division 08 Section Aluminum-Framed Entrances, Storefronts and Curtain Walls: Entrances furnished and installed separately.
- E. Division 08 Section Door Hardware: Hardware to the extent not specified in this Section.
- F. Division 26 – Electrical: Electrical connections provided separately including conduit and wiring for power to automatic door operators.

1.03 DEFINITIONS

- A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.
- B. Consciously initiating the opening of a power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.

1.04 REFERENCE STANDARDS

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. American Architectural Manufacturers Association (AAMA):
- C. AAMA 607.1 - Clear Anodic Finishes for Architectural Aluminum.
- D. American Association of Automatic Door Manufacturers (AAADM).
- E. American National Standards Institute (ANSI)/Builders' Hardware Manufacturers Association (BHMA):
- F. ANSI/BHMA A156.10: Standard for Power Operated Pedestrian Doors.
- G. ANSI/BHMA A156.19: Standard for Power Assist and Low Energy Power Operated Doors.
- H. American Society for Testing and Materials (ASTM):
- I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- K. International Code Council (ICC):
- L. IBC: International Building Code.
- M. International Standards Organization (ISO):
- N. ISO 9001 - Standard for Manufacturing Quality Management Systems.

- O. ISO 14025 – Environmental Labels and Declarations -- Type III Environmental Declarations -- Principles and Procedures.
- P. ISO14040 – Environmental Management -- Life Cycle Assessment -- Principles and Framework.
- Q. ISO 14044 – Environmental Management -- Life Cycle Assessment -- Requirements and Guidelines.
- R. ISO 21930 – Sustainability in Buildings and Civil Engineering Works -- Core Rules For Environmental Product Declarations Of Construction Products And Services.
- S. National Association of Architectural Metal Manufacturers (NAAMM):
- T. Metal Finishes Manual for Architectural and Metal Products.
- U. National Fire Protection Association (NFPA):
- V. NFPA 101 – Life Safety Code.
- W. NFPA 70 – National Electric Code.
 - 1. Underwriters Laboratories (UL):
- X. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- Y. United Nations Central Product Classification (UNCPC):
- Z. UNCPC 4212 - Product Category Rules for Preparing an Environmental Product Declaration for Power-Operated Pedestrian Doors and Revolving Doors.

1.05 COORDINATION

- A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic door operators to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to, power supplies, remote activation devices.

1.06 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Section 01 30 00 – Administrative Requirements: Submittal procedures.
- B. Action Submittals:
- C. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work. Indicate wiring for electrical supply.
- D. Color Samples for selection of factory-applied color finishes.
- E. Information Submittals:
- F. Evaluation Service Reports: Based on evaluation performed by a qualified agency, for automatic entrance door assemblies.
 - 1. Environmental Product Declaration.
 - 2. Evaluation Report for compliance with IBC.
- G. Closeout Submittals: Provide the following with project close-out documents.
- H. Owner’s Manual.
- I. Warranties.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain automatic door operators through one source from a single manufacturer.
- B. Qualifications
- C. Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained for installation and maintenance of units required for this Project.
- D. Manufacturer Qualifications: A qualified manufacturer with a manufacturing facility compliant with ISO 9001.

- E. Manufacturer shall have in place a national service dispatch center providing 24 hours a day, 7 days a week, emergency call back service.
- F. Certifications:
- G. Automatic door operators shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:
 - 1. ANSI/BHMA A156.10 and A156.19.
 - 2. IBC.
 - 3. NFPA 101.
 - 4. UL 325 Listed.
- H. Environmental Product Declaration (EPD): EPD for automatic door operators shall be certified by the manufacturer to comply with the following:
 - 1. Prepared under Product Category Rule (PCR) UNCPC 4212.
 - 2. Conform to ISO standards 14025, 14040, 14044, 21930.
 - 3. Life Cycle Assessment Basis: Cradle to Gate, minimum.

1.08 FIELD CONDITIONS

- A. Field Measurements: General Contractor shall verify openings to receive automatic door operators by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight, and secure; substrates to be of proper dimension and material.
- C. Other trades: General Contractor Advise of any inadequate conditions or equipment.

1.09 WARRANTY

- A. Automatic door operators shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.
- B. During the warranty period the Owner shall engage a factory-trained technician to perform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form shall be submitted to the Owner.
- C. During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal working hours.

PART 2 PRODUCTS

2.01 AUTOMATIC DOOR OPERATORS

- A. Manufacturer: Stanley Access Technologies (www.stanleyaccess.com); M-Force™ Series automatic door operator.
- B. Substitutions: See Division 1, Section 01 25 00 Substitution Procedures.
- C. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of swinging doors equipped with automatic door operators and are based on specific system indicated. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.02 PERFORMANCE / DESIGN CRITERIA

- A. General: Provide automatic door operators capable of withstanding loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Operating Range: Minus 30 deg F (Minus 34 deg C) to 130 deg F (54 deg C).
- C. Opening-Force Requirements for Egress Doors: In event power failure to operator, swinging automatic entrance doors shall open with manual force, not to exceed 30 lbf (133 N) to set door in motion, and not more than 15 lbf to fully open door. Forces shall be applied at 1" (25 mm) from the latch edge of door.

2.03 REGULATORY REQUIREMENTS

- A. Power Operated Door Standard: ANSI/BHA A156.19.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for swinging automatic entrance doors serving as a required means of egress.

2.04 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- B. Headers: 6063-T6.
- C. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
- D. Sheet and Plate: ASTM B 209.

2.05 COMPONENTS

- A. Header Case: Header case shall not exceed 6" (152 mm) square in section and shall be fabricated from extruded aluminum with structurally integrated end caps, designed to conceal door operators and controls. The operator shall be sealed against dust, dirt, and corrosion within the header case. Access to the operator and electronic control box shall be provided by a full-length removable cover, edge rabbeted to the header to ensure a flush fit. Removable cover shall be secured to prevent unauthorized access.
- B. Door Arms: combination of door arms and linkage shall provide positive control of door through entire swing; units shall permit use of butt hung, center pivot, and offset pivot-hung doors.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- D. Signage: Provide signage in accordance with ANSI/BHMA A156.19.

2.06 SWINGING DOOR OPERATORS

- A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
- B. Electromechanical Operators: Self-contained unit powered by a minimum 3/16 horsepower, permanent-magnet DC motor; through a high torque reduction gear system.
- C. Operation: Power opening and spring closing.
- D. Operator Type: Low energy; readily convertible to full energy; no tools required to change type.
- E. Handing: Non-handed; no tools required to change handing.
- F. Capacity: Rated for door panels weighing up to 700 lb (318 kg).
- G. Mounting: Visible.
- H. Features:
 - 1. Adjustable opening and closing speeds.
 - 2. Adjustable opening and closing force.
 - 3. Adjustable back-check.
 - 4. Adjustable hold-open time between 0 and 30 seconds.
 - 5. Reverse on obstruction.
 - 6. Time delay for electric lock integration.
 - 7. Force compensation and closed loop speed control with active braking and acceleration.
 - 8. Power Close.
 - 9. Slam Protection.
 - 10. Power Assist.
 - 11. Lock Release.

12. Stall Sensor Ignore.
 13. Electronic Coordination.
 14. Optional Switch to open/Switch to close operation.
 15. Optional push to activate operation.
 16. Fire alarm interface, configurable to safely open or close doors on signal from fire alarm system.
- I. Field Adjustable Spring Closing Operation: Operator shall close door by spring energy employing motor, as dynamic brake to provide closing speed control. Closing spring shall be helical compression spring, adjustable for positive closing action. Spring shall be adjustable, without removing the operator from header, to accommodate wide range of field conditions.
 - J. Independent Adjustable Closing and Latching Speed Control: Operator shall employ a rheostat module to allow for independent field adjustment of closing and latching speeds using the motor as a dynamic brake.
 - K. Field Adjustable Open Stop: Operator shall provide a field adjustable open stop to accommodate opening angles from 80 to 135 degrees without need for additional components.
 - L. Consistent Cycle: Operator shall deliver even, consistent open manual push force across entire transition from door fully closed to door fully open. Additionally, force shall be field adjustable to accommodate wide range of on-site conditions.
 - M. Quiet Performance: Operator shall be designed to output audible noise ratios less than or equal to 50dba.
 - N. Manual Use: Operator shall function as manual door closer in the direction of swing with or without electrical power. Operator shall deliver an even, consistent open force across entire transition from door fully closed to door fully open.
 - O. Electrical service to door operators shall be provided under Division 26 Electrical. Minimum service to be 120 VAC, 5 amps.

2.07 ELECTRICAL CONTROLS

- A. Electrical Control System: Electrical control system shall include microprocessor controller and a high-resolution position encoder. Encoder shall monitor revolutions of operator shaft and send signals to microprocessor controller to define door position and speed.
- B. High-resolution encoder shall have resolution of not less than 1024 counts per revolution. Systems utilizing external magnets and magnetic switches are not acceptable.
- C. Electrical control system shall include a 24 VDC auxiliary output rated at 1 amp.
- D. Performance Data: Microprocessor shall collect, and store performance data as follows:
- E. Counter: A non-resettable counter to track operating cycles.
- F. Event Reporting: Unit shall include non-volatile event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
- G. LED Display: Display presenting the current operating state of controller.
- H. Controller Protection: The microprocessor controller shall incorporate the following features to ensure trouble free operation:
 - I. Automatic Reset Upon Power Up.
 - J. Main Fuse Protection.
 - K. Electronic Surge Protection.
 - L. Internal Power Supply Protection.
 - M. Resettable sensor supply fuse protection.
 - N. Motor Protection, over-current protection.
 - O. Power Close: When enabled, engages the operator to close a door that does not close completely at the end of a cycle.

- P. Force Compensation: Utilizing the closed loop speed control, the operator shall maintain constant opening and closing speeds when subjected to excessive outside forces, such as positive or negative stack pressures.
- Q. Slam Protection: The operators speed control system prevents door from slamming at the full open or full closed position.
- R. Power Assist: Operator mode that lowers opening forces when the door is used manually. Power assist is active only while pushing or pulling the door. The door will close when an opening force is no longer applied.
- S. Lock Release: On doors with electric locking, operator shall include a closing function to release tension on a latch mechanism prior to opening the door.
- T. Stall Sensor Ignore: Adjustable setting to disable swing side safety sensors at a specific angle.
- U. Electronic Coordination: On pairs of doors, allows independent timing of opening and closing of each leaf as required for astragal coordination.
- V. Soft Start/Stop: A "soft-start" "soft-stop" motor driving circuit shall be provided for smooth normal opening and recycling.
- W. Obstruction Recycle: Provide system to recycle the swinging panels when an obstruction is encountered during the closing cycle.
- X. Programmable Controller: Microprocessor controller shall be field programmable.
- Y. The following parameters may be adjusted:
 - 1. Operating speeds and forces as required to meet specified ANSI/BHMA standard.
 - 2. Adjustable and variable features specified.
- Z. Manual programming shall be available through local interface which has a two-digit display with a selection control including three push buttons.
- AA. Emergency Breakout Switch: Cam actuated emergency breakout switch shall be provided to disconnect power to motor when in-swinging door is manually pushed in emergency out direction. Operator will then automatically reset, and power will be resumed.
- BB. Control Switch: Automatic door operators shall be equipped with three-position function switch to control operation of the door. Control switch shall provide three modes of operation, Automatic, Off, and Hold-Open.
- CC. Power Switch: Automatic door operators shall be equipped with two position On/Off switch to control power to the door.

2.08 ACTIVATION DEVICES

- A. Push Plates: Provide 4 1/2 inch (114 mm) square push plates with UL recognized SPDT switch. Face plates and mounting studs shall be stainless steel. Face plates shall be engraved with international symbol for accessibility and "Push To Open".
- B. Push plates shall be wall mounted in single or double gang electrical boxes and hardwired to door operator controls.
- C. Push Plates shall be similar to or better than the following:
 - 1. BEA, 10BPBS451.
 - 2. BEA, 10BDGP1

2.09 ALUMINUM FINISHES

- A. General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.40 mils minimum complying with AAMA 611-98, and the following:
- C. AAMA 607.1

- D. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of swinging automatic entrance doors. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.
- B. Mounting: Install automatic door operators/headers plumb and true in alignment with established lines and grades. Anchor securely in place.
- C. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
- D. Set headers, arms, and linkages level and true to location with anchorage for permanent support.
- E. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 – Electrical.

3.03 FIELD QUALITY CONTROL

- A. Testing Services: Factory Trained Installer shall test and inspect each swinging automatic entrance door to determine compliance of installed systems with applicable ANSI standards.

3.04 REPAIR

- A. Repair damaged finish to match original finish.

3.05 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in specified ANSI/BHMA operating standard by AAADM Certified Technician.

3.06 CLEANING

- A. Clean surfaces promptly after installation. Remove excess sealant compounds, dirt, and other substances.

END OF SECTION

**SECTION 08 80 00
GLAZING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
- B. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- I. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- J. GANA (GM) - GANA Glazing Manual; 2022.
- K. GANA (SM) - GANA Sealant Manual; 2008.
- L. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2016).
- M. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
- O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. A. See Section 01 31 00 - Project Management and Coordination, for project coordination requirements.
- B. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit three samples 12 by 12 inch in size of glass units.
- E. Certificate: Certify that products of this section meet or exceed specified requirements.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.07 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Glass Fabricators:
 - 1. Oldcastle Building Envelope: www.obe.com.
 - 2. Viracon, Inc: www.viracon.com/#sle.
- B. Float Glass Manufacturers:
 - 1. AGC Glass North America, Inc; _____: www.agcglass.com/#sle.
 - 2. Cardinal Glass Industries; _____: www.cardinalcorp.com/#sle.
 - 3. Guardian Glass, LLC: www.guardianglass.com.
 - 4. Pilkington North America Inc: www.pilkington.com/na/#sle.
 - 5. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Design Pressure: Calculated in accordance with ASCE 7.
 - 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 4. Glass thicknesses listed are minimum.
- B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
 - 1. In conjunction with weather barrier related materials described in other sections, as follows:

- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 2. Thicknesses: 1/4" minimum or provide greater thickness as required for exterior glazing wind load design.

2.04 INSULATING GLASS UNITS

- A. Manufacturers:
1. Glass: Any of the manufacturers specified for float glass.
- B. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 3. Warm-Edge Spacers: Low-conductivity thermoplastic with desiccant warm-edge technology design.
 - a. Spacer Width: As required for specified insulating glass unit.
 - b. Spacer Height: Manufacturer's standard.
 4. Spacer Color: Black.
 5. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
 6. Color: Black.
 7. Purge interpane space with dry air, hermetically sealed.

2.05 BASIS OF DESIGN - INSULATING GLASS UNITS

- A. Type G-1 - Insulating Glass Units: Vision glazing, with Low-E coating.
1. Applications: Exterior insulating glass glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Total Thickness: 1 inch.
 4. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: SolarBan 70, Solar Bronze on #2 surface.
 5. Inboard Lite: Fully tempered float glass, 1/4 inch thick.
 - a. Tint: Clear.
 6. Thermal Transmittance (U-Value), Winter - Center of Glass, Nighttime: 29, nominal.
 7. Visible Light Transmittance (VLT): 51 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 23, nominal.
 9. Visible Light Reflectance, Outside: 12 percent, nominal.
 10. Glazing Method: Dry glazing method, gasket glazing.

2.06 GLAZING UNITS

- A. Type G-2 - Monolithic Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Fully tempered float glass.

3. Tint: Clear.
4. Thickness: 1/4 inch, minimum nominal.
5. Glazing Method: Dry glazing method, tape and tape.

2.07 GLAZING COMPOUNDS

- A. Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
- B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
- C. Manufacturers:
 1. BASF Corporation: www.basf.com/us/en.html/#sle.
 2. Bostik Inc: www.bostik-us.com.
 3. Dow Corning Corporation: www.dowcorning.com/construction.
 4. Pecora Corporation: www.pecora.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.08 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.
- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- E. Place glazing tape on free perimeter of glazing in same manner described above.
- F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- G. Carefully trim protruding tape with knife.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for contractor quality control requirements.
- B. Inspect glass installations, types, thickness and glazing methods.
- C. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.
- D. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- E. Monitor and report installation procedures and unacceptable conditions.

3.07 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.08 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

08 80 00 - Glazing

- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

**SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile and stone tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Testing of existing concrete floor slabs for moisture and alkalinity (pH) has already been conducted; test report is attached.
- F. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- G. Patching compound.
- H. Remedial floor coatings.
- I. Remedial floor sheet membrane.
- J. Preparation of new and existing wood-based floors and subfloors for installation of new floor coverings.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.
- B. Section 03 30 00 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.
- C. Section 03 30 00 - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.
- D. Section 03 30 00 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - 3. Manufacturer's installation instructions.
 - 4. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- D. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Product data for recommended remedial coating.
 - 7. Submit report to Architect.
 - 8. Submit report not more than two business days after conclusion of testing.
- E. Adhesive Bond and Compatibility Test Report.
- F. Copy of RFCI (RWP).

1.06 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.

- C. Keep materials from freezing.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 - 2. Use product recommended by testing agency.
- C. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
 - 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering.
 - 2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - 3. Preliminary cleaning.
 - 4. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 - 5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 7. Specified remediation, if required.
 - 8. Patching, smoothing, and leveling, as required.
 - 9. Other preparation specified.
 - 10. Adhesive bond and compatibility test.

11. Protection.

C. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.06 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.07 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.08 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.09 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.10 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. Install in accordance with sheet membrane manufacturer's instructions.

END OF SECTION

**SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Gypsum sheathing.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.
- I. Textured finish system.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 27 20 - Fluid-Applied Air and Water Barrier
- C. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- D. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).
- B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- D. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- E. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
- F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- H. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- I. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- J. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- K. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- L. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- M. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
- N. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm)

- in Thickness; 2022.
- O. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
 - P. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
 - Q. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
 - R. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
 - S. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018 (Reapproved 2023).
 - T. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
 - U. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
 - V. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.
 - W. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
 - X. ASTM E413 - Classification for Rating Sound Insulation; 2022.
 - Y. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.
 - Z. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.
 - AA. GA-600 - Fire Resistance and Sound Control Design Manual; 2021.
 - BB. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum[5]years of experience.
- B. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
 - 1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

- B. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 2. Marino: www.marinoware.com/#sle.
 - 3. SCAFCO Corporation: www.scafco.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 7.5 psf for walls receiving ceramic tile. L/120 at 5 psf for all other walls.
 - 1. Studs: C-shaped with knurled or embossed faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
- D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
 - 3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
 - 4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
 - a. Products:
 - 1) ClarkDietrich; BlazeFrame RipTrak: www.clarkdietrich.com/#sle.
 - 2) FireTrak Corporation; Posi Klip: www.fire-trak.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
- E. Non-structural Framing Accessories:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 - 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 - a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
 - b. Products:
 - 1) ClarkDietrich; Pony Wall (PW): www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- F. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
 - 1. Products:
 - a. USG Corporation; Drywall Suspension System: www.usg.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 - 2. National Gypsum Company: www.nationalgypsum.com/#sle.
 - 3. USG Corporation: www.usg.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.

2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 3. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
- C. Backing Board For Wet Areas:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
 2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Products:
 - 1) Custom Building Products: www.custombuildingproducts.com/#sle.
 - 2) PermaBASE Building Products, LLC provided by National Gypsum Company; PermaBase Cement Board: www.goldbondbuilding.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 3. Type: Regular and Type X, in locations indicated.
 4. Type X Thickness: 5/8 inch.
 5. Regular Board Thickness: 5/8 inch.
 6. Edges: Tapered.
 7. Products:
 - a. Georgia-Pacific Gypsum; ToughRock Mold-Guard Gypsum Board: www.gpgypsum.com/#sle.
 - b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
 2. Thickness: 5/8 inch.
 3. Edges: Tapered.
- F. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
 2. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 3. Core Type: Regular and Type X, as indicated.
 4. Type X Thickness: 5/8 inch.
 5. Regular Board Thickness: 5/8 inch.
 6. Edges: Square.
 7. Glass Mat Faced Products:
 - a. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
 - b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.

2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
3. Types: Regular and Type X, in locations indicated.
4. Type X Thickness: 5/8 inch.
5. Regular Type Thickness: 5/8 inch.
6. Edges: Tapered.

2.04 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 inch.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Water-Resistive Barrier: As specified in Section 07 27 20.
- D. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
 1. Types: As detailed or required for finished appearance.
 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
 3. Architectural Reveal Reglets: Provide extruded aluminum shapes; prefinished color anodized.
 - a. Shapes and configurations as shown on Drawings.
 - b. Finish to be selected by Architect from manufacturer's complete line of products and options.
 - c. Manufacturer: Fry Reglet; fryreglet.com
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 2. Joint Compound: Setting type, field-mixed.
- F. Finishing Compound: Surface coat and primer, takes the place of skim coating.
- G. Textured Finish Materials: Latex-based compound; plain.
- H. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- I. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.
- J. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C1007/AISI S220 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center.
 1. Level ceiling system to a tolerance of 1/1200.
 2. Laterally brace entire suspension system.
 3. Install bracing as required at exterior locations to resist wind uplift.
- C. Studs: Space studs at 16 inches on center.
 1. Extend partition framing to structure where indicated and to ceiling in other locations.

2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
1. Orientation: Horizontal.
- F. Blocking: Install wood blocking for support of:
1. Framed openings.
 2. Wall-mounted cabinets.
 3. Toilet partitions.
 4. Toilet accessories.
 5. Wall-mounted door hardware.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
1. Place one bead continuously on substrate before installation of perimeter framing members.
 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
- F. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
1. Seal joints, cut edges, and holes with water-resistant sealant.
- G. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- H. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
- I. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30 feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.
- D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

3.06 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 3. Level 3: Walls to receive textured wall finish.
 - 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 5. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TEXTURE FINISH

- A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

3.08 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

**SECTION 09 30 00
TILING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
- B. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
- C. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2019.
- D. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.
- E. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
- F. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2014 (Reaffirmed 2019).
- G. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2019.
- H. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- I. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
- J. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- K. ASTM D4068 - Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane; 2017 (Reapproved 2022).
- L. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- M. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- N. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.
- O. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. See Section 01 3100 - Project Management and Coordination, for project coordination requirements.

- B. Finish Preinstallation Meeting: See Section 09 0500 - Common Work Results for Finishes for Interior Finish Preinstallaton Meeting and coordination requirements.
- C. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.
 - 1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
 - 2. Agenda:
 - a. Tour, inspect and discuss substrate conditions at tile installation locations and other preparatory work performed by other trades.
 - b. Review tile installation requirements (Drawings, Specifications and other Contract Documents).
 - c. Review required submittals, both completed and yet to be completed.
 - d. Review tile installation Shop Drawings.
 - e. Review and finalize construction schedule related to tile installation work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - f. Review safety precautions relating to installation of wall and floor tile.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.
 - 1. Indicate TCA installation method for each type of tile installation for each setting detail.
 - 2. Submit setting details for elevator cab floor tile installation.
- D. Samples for Selection: Manufacturer's complete set of grout color samples for Architect initial color selection.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 10 square feet of each size, color, and surface finish combination.
 - 3. Box materials and identify by , manufacturer, type and color.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of ANSI A108/A118/A136, TCNA (HB), and TCNA (HB-GP) on-site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 60 00 - Product Requirements, for general requirements for transporting, handling, storing and protecting Products.
- B. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- C. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

- D. Store tile and installation system materials in a dry location; handle in a manner to prevent chipping, breakage, and contamination.
- E. Store portland cement mortars and grouts in a dry location.
- F. Project Field Superintendent shall inspect Products immediately upon delivery to Project Site, determine Product conformance with specified requirements and reject Products not complying with specifications. Project Field Superintendent shall direct that non-complying Products be removed from Project Site immediately.
- G. Deliver Material Safety Data Sheet (MSDS) for each material to Project Field Superintendent for Contractor Records.

1.08 FIELD CONDITIONS

- A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during and after installation.
- B. Do not begin installation until building is completely enclosed and HVAC system is operating and maintaining temperature and humidity conditions consistent with "after occupancy" conditions for a minimum of 14 days.
- C. Maintain continuous and uniform building temperatures of not less than 50 degrees F during installation nor more than 90 degrees F.
- D. Do not install solvent-based products in an unventilated environment.
- E. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers: As per Room Finish Legend listing.
- B. Refer to "Room Finish Legend" on Room Finish Schedule Drawing for tile selections and descriptions.
- C. Substitutions: See Section 01 60 00 - Product Requirements and Section 01 25 00 - Substitution Procedures.
 - 1. Substitutions must be equal to selected finishes. All substitutions must provide side-by-side comparisons with the selected product including: samples, physical size data, ANSI standards compliance, moisture absorption, surface finish, and coordinating trim units.

2.02 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer
- B. Manufacturers:
 - 1. Custom Building Products: www.custombuildingproducts.com.
 - 2. LATICRETE International, Inc: www.laticrete.com.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
 - 4. Note: Provide setting materials made by the same manufacturer as grout.
- C. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
 - 1. Applications: Use this type of bond coat where indicated.
 - 2. Products:
 - a. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc; TRI-LITE: www.laticrete.com/#sle.
- D. Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
 - 1. Applications: Use this type of bond coat where required.
 - 2. Products:

- a. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer:
www.custombuildingproducts.com.
 - b. LATICRETE International, Inc; LATICRETE 254 Platinum: www.laticrete.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements and Section 01 2500 - Substitution Procedures.
- E. Latex-Portland Cement Mortar Bond Coat: {rs\#1}, {rs\#1}, or [_____].
- F. Mortar Materials for Floor and Wall Installations and Large Format Tile: ANSI A118.4, ANSI A118.15, ANSI A118.11.
1. Applications: Use this product for floor and wall thin-set applications; Use this product with large format tile installed as a setting bed below the tile but above the waterproofing membrane and mortar bed
 2. Products:
 - a. LATICRETE International, Inc; LATICRETE Tri-Lite: www.laticrete.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Polymer modified adhesive mortar for thinset applications.
1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
 2. Products:
 - a. LATICRETE International, Inc; LATICRETE 255 MULTIMAX: www.laticrete.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
1. Applications: For all tile locations.
 2. Grout Joint Width for Large Format Tile: 3/16 inch.
 3. Color(s): As selected by Architect from manufacturer's full line.
 4. Products:
 - a. Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout:
www.custombuildingproducts.com.
 - b. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout:
www.laticrete.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements and Section 01 2500 - Substitution Procedures.

2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
1. Applications: Between tile and plumbing fixtures.
 2. Applications: Tile movement joints
 3. Color(s): to match grout.
 4. Products:
 - a. Custom Building Products; Commercial 100% Silicone Caulk:
www.custombuildingproducts.com.
 - b. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements and Section 01 2500 - Substitution Procedures.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.
 2. Verify compatibility with selected grout product.

2.06 ACCESSORY MATERIALS

- A. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber.
 - b. At large format tile installations, install between mortar bed and setting bed per manufacturer's instructions.
 - c. Products:
 - 1) LATICRETE International, Inc; LATICRETE HYDRO BAN:
www.laticrete.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- B. Waterproofing Membrane Under Thick Mortar Bed at Showers and Tiled Tubs:
 - 1. Material: Chlorinated polyethylene sheet, 40 mils thick, minimum; complying with ASTM D4068.
- C. Cleavage Membrane Under Thick Mortar Bed:
 - 1. Material: 4 mil thick polyethylene film.

PART 3 EXECUTION

3.01 EXAMINATION

- A. See Section 01 73 00 - Execution Requirements, for general requirements for verification of existing conditions before starting work.
- B. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
- C. Verify that floor drains are of proper type and are set at proper height to receive ceramic floor tile flush with drain.
- D. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- E. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- F. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- G. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
 - 2. Follow moisture and alkalinity remediation procedures in Section 09 05 61.
- H. Verify that required floor-mounted utilities are in correct location.
- I. Report in writing to Architect 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.
- J. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Prepare substrate surfaces for installation in accordance with tile setting material manufacturer's instructions. Scarify concrete surfaces with blast track equipment if necessary.

- E. Blending: For tile exhibiting color variations within color ranges selected, verify that tile has been blended at factory and packaged so tile taken from package show same color ranges as those taken from other packages. If not factory blended, return to manufacturer or blend tiles at Project Site before installing.

3.03 INSTALLATION - GENERAL

- A. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly.
- B. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- C. Form internal angles square and external angles square.
- D. Sound tile after setting. Replace hollow sounding units.
- E. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- F. Grout tile joints unless otherwise indicated.
- G. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- H. Floor Mounted Plumbing Fixtures: Install finish floor before installation of floor mounted plumbing fixtures.

3.04 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F101, bonded, with epoxy grout.
- B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F112, bonded.
 - 1. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with TCNA (HB) Method F121.
 - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F132, bonded.
- C. Cleavage Membrane: Lap edges and ends.
- D. Waterproofing Membrane: Install as recommended by manufacturer _____.

3.05 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Contractor Quality Control Representative shall perform contractor quality control inspections.
 - 1. Document preparatory, initial and follow-up inspection in Contractor's Test and Inspection Reports.
 - 2. Test and Inspection Reports shall be available to Architect upon request.
- B. Inspect ceramic floor tile and base installation and adherence to substrate.
- C. Inspect tile layout, grout joints, joint alignment, color and style.
- D. Inspect floor tile installation interface with floor drain strainer and ensure floor drains are flush with floor tile, neatly cut to fit around floor drain and that joints around drain are tight and uniform.
 - 1. Reject tile installation or floor drain installation that does not comply with joint or levelness requirements and require the necessary removal for proper re-installation.
 - 2. Obtain Architect approval of drain and tile interface installation.
- E. Document preparatory, initial and follow-up inspection in Contractor's Test and Inspection Reports.
- F. Test and Inspection Reports shall be available to Architect upon request.
- G. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.

3.06 CLEANING

- A. Clean tile and grout surfaces.
- B. Clean excess mortar from surface with water as work progresses. Perform cleaning while mortar is fresh and before it hardens on surfaces.
- C. Sponge and wash tile diagonally across joints. Polish with clean dry cloth.
- D. Remove grout haze following recommendation of mortar additive manufacturer. Do not use acids for cleaning.
- E. Clean tile and grout surfaces.
 - 1. Upon completion of installation.
 - 2. Just before Substantial Completion Inspection.

3.07 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.
- B. Cover tile floors with kraft paper, masked in place. Do not remove until cleaning for Substantial Completion inspection.
- C. Where temporary use of new floors is unavoidable, provide large flat boards or plywood panels for walkways over kraft paper.

3.08 SCHEDULE

- A. Refer to the Interior Finish Legend and the Room Finish Schedule for tile descriptions and locations of installation.

END OF SECTION

**SECTION 09 91 23
INTERIOR PAINTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and stains.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Prime surfaces to receive wall coverings.
 - 3. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In all areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - d. Paint dampers exposed behind louvers, grilles, to match face panels.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
 - 10. Glass.
 - 11. Concrete masonry units in utility, mechanical, and electrical spaces.
 - 12. Acoustical materials, unless specifically indicated.
 - 13. Concealed pipes, ducts, and conduits.
 - 14. Electrical and communications cables:
 - a. Coordinate paint and cable installation schedule with Electrical Contractor and Telecommunications Contractor. Protect cabling from direct painting or over-spray. Cables which have been painted are void of manufacturer warranty and shall be replaced by Painting Contractor at Painting Contractor's expense and no additional cost to Owner.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Shop-primed items.
- B. Section 06 20 00 - Finish Carpentry: Wood and MDF substrates.
- C. Section 09 05 00 - Common Work Results for Finishes: Overall interior finish preinstallation meeting.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.
- B. Standard Definitions for Paint Sheen:
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.

2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.04 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2023.
- B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2023.
- C. ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness by Notch Gages; 2013.
- D. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- E. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- F. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- G. PDCA P1 - Touch Up Painting and Damage Repair, Current Edition.
- H. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- I. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- J. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. See Section 01 3100 - Project Management and Coordination, for project coordination requirements.
- B. Coordination: Coordinate the application of paint coatings with specified paint finishes and colors. Coordinate size and locations of paint mock-ups. Ensure that all items that do not receive paint coatings are masked and completely protected from overspray from paint application operations.
- C. Preinstallation Meeting: See Section 09 0500 - Common Work Results for Finishes for Mandatory Interior Finish Preinstallation Meeting and coordination requirements.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 2. Cross-reference to specified paint system products to be used in project; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 1. Where sheen is specified, submit samples in only that sheen.
- D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
3. Label each container with color, type, sheen in addition to manufacturer's label:
 - a. Provide a separate label that includes manufacturer, type of paint, paint color name, color formula code and locations where paint and color were applied.
 - b. Label shall be printed and covered with clear packing tape to preserve information.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum 5 years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years experience.
- C. Documentation of Coats and Coat Thickness: Contractor shall document that specified number of coats were applied to each surface and that wet film thickness was measured and complied with specified minimum thickness as specified in Field Quality Control article in this Section.
 1. Verification in Architect's Presence: If required by Architect, Contractor shall apply paint coats and verify specified wet film thickness of coats utilizing a notched-type wet film thickness gage, in conformance with ASTM D 4414, in Architect's presence at locations determined by Architect.

1.08 MOCK-UP

- A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up and Section 09 0500 - Common Work Results for Finishes for coordination.
- B. Provide panel, 6 feet long by 6 feet wide, illustrating each paint color, texture, and finish.
- C. Provide door and frame assembly illustrating paint color, texture, and finish.
- D. Locate where directed by Architect.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Transport, handle, store, and protect Products.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Accept Products on site in manufacturer's packaging. Inspect for damage. Return damaged Products and replace with undamaged Products.
- D. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- E. Project Field Superintendent shall inspect Products immediately upon delivery to Project Site, determine Product conformance with specified requirements and reject Products not complying with specifications. Project Field Superintendent shall direct that non-complying Products be removed from Project Site immediately.
- F. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
- G. Deliver Material Safety Data Sheet (MSDS) for each material to Project Field Superintendent for Contractor Records.

1.10 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Sherwin Williams Company: www.sherwin-williams.com.
- B. Other Acceptable Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below.
 - 1. Benjamin Moore & Company: www.benjaminmoore.com.
 - 2. PPG Paints: www.ppgpaints.com.
- C. Substitutions: See Section 01 6000 - Product Requirements and Section 01 2500 - Substitution Procedures.
 - 1. For any product not identified as "Basis of Design," submit information as specified for substitutions.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- C. Colors: As indicated on drawings "Room Finish Schedule."
 - 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 - 2. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.
 - 3. Hollow Metal Door and Frame Colors: Indicated on Drawing "Door Schedule" Sheet Notes - Doors.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, aluminum, and acoustical ceilings.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
 - 3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - b. Eggshell: MPI gloss level 3; use this sheen at all locations.
 - 4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
 - 1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
 - 2. Two top coats and one coat primer.
 - 3. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
 - 4. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
 - 5. Primer: As recommended by top coat manufacturer for specific substrate.

- C. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead in all wet areas including restrooms, laundry room, showers, whirlpool room including gypsum board, plaster, concrete, concrete masonry units, uncoated steel, shop primed steel, galvanized steel, and aluminum.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.
 - 3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - b. Satin: MPI gloss level 4; use this sheen at all other locations.
- D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, galvanized piping, and _____.
 - 1. Shop primer by others.
 - 2. One top coat _____.
 - 3. Top Coat: Latex Dry Fall; MPI #118, 155, or 226.
- E. Paint I-TR-C - Transparent Finish on Concrete Floors.
 - 1. To be provided if not covered in another specification section.
 - 2. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
 - a. Products:
 - 1) Sherwin-Williams H&C Clarishield Water-Based Wet-Look Concrete Sealer. (MPI #99)
 - 3. Sealer Sheen:
 - a. Eggshell: MPI gloss level 3; use this sheen at all locations.
- F. Paint CI-OP-2A - Concrete Masonry, Opaque, Latex, 3 Coat:
 - 1. Primer: PrepRite Interior/Exterior Block Filler: B25W25; WFT 16.0 mils, DFT 8 mils.
 - 2. Semi-Gloss: Two coats of latex enamel
- G. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
 - 1. Touch-up with latex primer.
 - 2. Eggshell: Two coats of latex enamel; _____.
- H. Paint Mgl-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
 - 1. One coat galvanize primer.
- I. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat:
 - 1. One coat of alkyd primer sealer.
 - 2. Eggshell: Two coats of latex-acrylic enamel; See Room Finish Schedule.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 - 1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.
 - 2. Interior/Exterior Latex Block Filler; MPI #4.
 - 3. Concrete Floor Primer, Waterborne.
 - 4. Interior Drywall Primer Sealer.
 - 5. Alkyd Primer for Galvanized Metal.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 7300 - Execution Requirements: Verification of existing conditions before starting work.

- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Plaster and Stucco: 12 percent.
 - 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
 - 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 5. Concrete Floors and Traffic Surfaces: 8 percent.
- F. Report in writing to Architect 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.
- G. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Protect all adjacent surfaces and materials that will not receive paint coating before start of field painting operations to avoid any overspray.
 - 1. Project Field Superintendent shall inspect and ensure that all adjacent surfaces and materials are protected from any overspray possibility.
 - 2. Any adjacent surface or material that receives overspray shall be replaced by Painting Contractor at Painting Contractor's expense and no additional cost to Owner.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete:
 - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- H. Masonry:
 - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 - 2. Prepare surface as recommended by top coat manufacturer.
- I. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- J. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- K. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.
- L. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

- M. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
- N. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.
- O. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- P. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- F. Sand wood and metal surfaces lightly between coats to achieve required finish.
- G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 TOUCH-UP SITE VISIT PRIOR TO CERTIFICATE OF OCCUPANCY

- A. Contractor shall include 1 touch-up site visit to occur after all punch-list items by Contractor and all other Subcontractors have been completed. Perform interior and exterior painting touchup work just prior to issuance of the Certificate of Occupancy.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.
- B. Section 01 4000 - Quality Requirements: Contractor Quality Control Representative shall perform contractor quality control inspections.
 - 1. Document preparatory, initial and follow-up inspection in Contractor's Test and Inspection Reports.
 - 2. Test and Inspection Reports shall be available to Architect upon request.
- C. Measure air temperature, surface temperature and relative humidity before start of painting operations for each area.
- D. Inspect cleaning and preparation of surfaces. Inspect paint and finish application for scheduled material, color and sheen.
- E. Verify specified dry film thickness (DFT) and coverage of each wall or coated area with notched-type wet film thickness gage in accordance with ASTM D 4414.
- F. Coating Thickness Tests:

1. Should Architect or Owner have doubt about dry film thickness of coating applied, Architect may require Contractor to perform dry film thickness tests , utilizing a non-destructive electronic dry film thickness gage at locations determined by Architect, at Contractor's expense.
- G. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.

3.06 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. After completing application of coatings clean spattered surfaces. Remove spattered coatings by washing and scraping. Do not scratch or damage adjacent finished surfaces.

3.07 PROTECTION

- A. Protect work of other trades, whether beign painted or not, against damage by painting. Correct damage by cleaing, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
- C. At completion of construction activities or other trades, touch-up and restore damaged or defaced painted surfaces. Comply with prodedures specified in PDCA P1.

END OF SECTION

10 14 30 – OUTDOOR SIGNAGE REPLACEMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SCOPE

- A. All materials, components, and services necessary to provide a complete system indicated in this Section, as specified herein and shown on related Drawings, including:
 - 1. Verification of dimensions and conditions at the job site.
 - 2. Preparation and submission of complete shop drawings and samples for approval prior to fabrication.
 - 3. Shipment of equipment to the job site and the secured storage of all non-fixed equipment.
 - 4. Installation and completion in accordance with these Specifications, related Drawings, the Outdoor Signage Manufacturer's recommendations, established trade criteria, and all applicable code requirements.
 - 5. The inspection, demonstration, and necessary adjustment of the completed installation by the Outdoor Signage Manufacturer's engineering personnel.
 - 6. Preparation and submission of complete record drawings and operational and maintenance data and certificates.

1.03 WORK INCLUDED

- A. The following is for reference only and is not intended to define the limits of the work for a complete installation:
 - 1. LED message centers
 - 2. Control software

1.04 ALTERNATES

- B. Provide individual bids for each of the alternates identified herein and shown on related Drawings.
 - 1. ALTERNATE #1: Provide pricing for alternate displays noted below.

1.05 REFERENCES

- A. Standard for Electric Signs, UL and CUL Listed
- B. Standard for Control Centers for Changing Message Type Signs
- C. Federal Communications Commission Regulation Part 15
- D. National Electric Code
- E. Designed to current UBC or IBC standards
- F. FCC Class A Compliant

1.06 SUBMITTAL

- A. With Bid:
 - 1. All LED display installer qualifications, as specified herein.
 - 2. All LED display manufacturer qualifications, as specified herein.
 - 3. Installer shall submit a complete bill of materials to be furnished.

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4. A list of any and all proposed deviations or exceptions from the contract Drawings and Specifications, whether or not these variations have been formally or informally accepted by Schuler Shook. Any deviations or exceptions from the Drawings or Specifications proposed after bid shall not be accepted.
 5. Manufacturer shall indicate any additional wire or conduit runs that are not shown on the Drawings that will be required to install Manufacturer's system.
 6. A schedule for the anticipated completion of the following:
 - a. Shop drawings.
 - b. Delivery of all equipment.
 - c. Commissioning of all systems.
- B. Shop Drawings:
1. The electronic LED display installer shall provide a complete technical submittal within 45 days of contract award and shall not proceed with LED Matrix manufacture until the submittal is approved.
 2. The Submittal will include:
 - a. Dimensions, components, and finishes of all equipment and accessories.
 - b. All system assemblies and major sub-assemblies, cabinets, and enclosures, including notation of type and manufacture of switches, relays, locks, hardware, and electrical and electronic connectors.
 - c. Quantities of each component and sub-assembly.
 - d. Block schematics of system internal wiring and system element interconnection. Including but not limited to:
 - i. LED display Riser diagram.
 - ii. AC Site Power Requirements, including legs and Amps per leg.
 - e. Indication by boxed caption of any and all deviations or exceptions from the contract Drawings and Specifications, whether or not those variations have been formally or informally accepted by Schuler Shook.
 - f. Indication by boxed caption of any and all additional wire or conduit runs that are not shown on the Drawings that will be required to install Manufacturer's system.
- C. Final Submittal:
3. Within thirty (30) days of final tests, and as a condition for final approval, the Contractor shall submit three (3) bound sets to the Owner and one (1) bound set to Schuler Shook:
 - a. Receipts for delivery of all non-installed items, including all items designated, "deliver to Owner." Delivery receipts shall include name and quantity of each piece of equipment specified, with confirmation signature by Electrical Contractor or Owner's representative.
 - b. "As built and approved" CAD drawings and wiring diagrams showing all systems and components as installed, including all field modifications.
 - c. Operation and service manuals, schematics, and parts lists for each unit of equipment installed or provided. A printed, bound manual is required for each control console.
 - d. DVD copies of video-recorded instructions as described below.
 - e. Certificates of warranty, as set forth below.

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1.07 QUALITY ASSURANCE

- A. Signage Installer shall:
1. Have an established business with no less than 5 years of experience installing and servicing exterior LED digital signage.
 2. Submit a portfolio of completed LED digital signage projects similar in scope that have been completed in the past 4 years. Include references for each project.
 3. Submit names and qualifications of key team members.
 4. Hold any and all licensing and certifications required by the City of Tulsa, the State of Oklahoma or any other authority having jurisdiction.
 5. Reference for basis of design the following Daktronics quote number: Quote # 838660-1-0 , Contact Kevin Kantack at Kevin.Kantack@daktronics.com or 405-229-4473 for additional information.
- B. LED Display Manufacturer shall:
1. Have been in the business of manufacturing permanently mounted outdoor LED displays for a minimum period of 15 years prior to the contract bid date. An “LED” display contains pixels constructed solely of high-intensity discrete LEDs
 2. Have in operation at bid date a minimum of 100 large outdoor permanently mounted LED displays as defined above. Each of these LED displays shall have operated successfully for a minimum period of one (1) year prior to the contract bid date.
 3. Have been in business under the same corporate name for a period of no less than 40 years prior to the contract bid date.
 4. Provide a toll-free help desk number that will be staffed from 7 a.m. to 7 p.m.
- C. Experience with manufacturing the following types of electronic sign products shall not satisfy the requirements of this LED display specification:
1. Indoor displays of any size or type
 2. Back-lit displays
 3. Any type of matrix display that cannot be programmed to show a nearly infinite quantity of messages.

1.08 TESTING AND INSTRUCTION

- A. Upon completion of all installation work, the Contractor shall certify in writing to the Architect that the work is complete and ready for final inspection. Final inspection shall be scheduled by the Owner, Architect, and Schuler Shook within fourteen (14) days following Contractor’s notice of completion.
- B. After system commissioning and adjustment, a knowledgeable representative of the Manufacturer shall operate the system for the approval of the Owner and Schuler Shook.
- C. Necessary adjustments or modifications shall be made as required.
- D. Manufacturer’s representative shall instruct the Owner’s designated staff or representatives in the operation and maintenance of all equipment as follows:
1. The first instruction session shall encompass a complete and detailed orientation to the system, including all software and hardware. This instruction session shall be scheduled to last a minimum of four (4) hours.
 2. The second instruction session shall include a review of first session topics as requested by the Owner’s staff, as well as advanced software programming. The second session shall occur within sixty (60) days of the first session. This instruction session shall be scheduled to last a minimum of four (4) hours.

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- E. The Manufacturer shall provide to the Owner video-recorded instructions on the operation and maintenance of the system. Information contained in the video will cover all points of operation and maintenance covered in the first instruction session with the Owner's staff. A recording of the actual instruction session is acceptable. Provide electronic files of the video instruction.

1.09 WARRANTY

- A. Provide 5 years of parts coverage.
- B. For a period of two (2) years following final acceptance, the manufacturer and installer shall provide and install, at no cost to the Owner, software upgrades to all components of all control systems. Thereafter the installer shall notify the Owner of all software upgrades for the life of the control system(s). The Dealer shall keep the Owner's name and address in a database for this purpose. All upgrades shall include a full written description of operational modifications. Software upgrades shall be designed so as to allow all existing data, configurations and show files to be maintained, accessed and edited in the future.
- C. Provide toll-free service coordination.
- D. Provide a toll-free help desk number that will be staffed from 7 a.m. to 7 p.m. Central Time.
- E. Appropriate additional equipment to replace equipment removed for service shall be provided at the job site at no expense to the Owner. Replacement control console(s) must be of the same model as those removed for service.
- F. Warranty service shall be performed by personnel in the employ of the Outdoor Signage Manufacturer and shall not be sub-contracted or assigned to another company, service, or individual unless the Owner has approved such assignment in writing, in which event the Manufacturer shall nevertheless be responsible to the Owner for such work.

1.10 GENERAL REQUIREMENTS

- A. General Conditions of the project contract, work schedules, and site regulations apply to this work.
- B. This work shall comply with all applicable national and local labor regulations.
- C. All parts shall be new, of first quality, and under warranty.
- D. All work and products shall conform to all applicable national and local code requirements. It is the Contractors' responsibility to verify and comply with all national and local codes.
- E. All electrical work and products shall conform to all applicable NFPA 70 National Electric Code (NEC) standards.
- F. All components shall be UL listed and carry pertinent UL labels.
- G. All components shall bear labels identifying the manufacturer, model number, and serial number. All such labels and certificates shall be permanently attached in a conspicuous location.
- H. Identification:
 - 1. All control and receptacle faceplates shall be identified and legended with permanent markings.
 - 2. All control and receptacle faceplates not described elsewhere in this Specification shall be black anodized aluminum or black painted steel, and all labels and legends shall be permanently engraved directly into the faceplate. Minimum text height if not specified elsewhere: 1/4 inch. Engravings shall be filled with white paint. Lamacoid labels shall be acceptable if mechanically fastened to the panel.

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3. Dry transfers, decals, plastic “dymo”, or other types of adhesive labels shall not be used. Silk-screened labels or legends shall not be used.
4. All control and receptacle faceplates shall have beveled edges and rounded corners.
- I. All control, signal, and video connectors shall be of substantial construction and shall be of the locking or latching type. All plate-mounted connectors shall be bolted to faceplates, rivets shall not be acceptable.
- J. All components requiring external electrical connections of more than seven (7) conductors shall include barrier-type terminal strips properly sized and permanently labeled.
- K. Where specification allows for “approved equal,” substitutions shall be proposed to Schuler Shook no less than ten (10) days prior to bid date.
- L. All equipment shall be fully insured against loss or damage during shipment, job site storage, installation, and testing. The Contractor shall have and assume full responsibility for the safety of every unit of equipment, components, wiring, and plans during delivery, installation, and testing. Certification of such coverage shall be furnished to the Architect within thirty (30) days of award of contract.
- M. For a period of five (5) years following acceptance, the Manufacturer shall maintain service capability by guaranteeing a factory-authorized representative available for on-site service calls within twenty-four (24) hours of notification by Owner of a need for service.

PART 2 PRODUCTS

2.01 POLE MOUNTED THREE VIEW DISPLAY – BASE BID

A. LED DISPLAY

1. Cabinet Construction

- a. Cabinet dimensions 3' 8" H X 9' 5" W X 0' 5" D. The front-to-back cabinet depth shall not exceed 12 inches.
- b. The cabinet shall contain a full LED matrix measuring a minimum of 60 pixel rows high by 175 pixel columns wide.
- c. Cabinet display configuration is:
 - i. Three-View (3V), three sided display
- d. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 15.85mm both horizontally and vertically.
- e. Maximum display power per face shall not exceed 1050 watts when 100% of the pixels are operating at their maximum possible drive current.
- f. Cabinet weight per face shall not exceed 245 lbs.
- g. Display shall operate from the following power sources: 120/240 VAC, 60 Hz single-phase, including neutral and earth ground.
- h. Display shall operate in a minimum ambient temperature range of -40° to +120°F (-40 to +50°C) and to a 95% humidity.
- i. Internal display component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from stainless steel, aluminum, nylon, or other durable corrosion-resistant materials suitable for the signage application.
- j. Electrical display components shall be 100% solid-state.

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- k. The presence of ambient radio signals and magnetic or electromagnetic interference, including those from power lines, transformers, and motors, shall not impair performance of the display system.
- 2. Housing Frame
 - a. Display materials shall use non-corrosive materials or have a protective coating so they shall be anti-corrosive and not degrade or oxidize.
 - b. The display shall be rear ventilated with adequate ventilation provided by the use of fans.
 - c. Steel mounting points that can be used for mounting purposes shall be provided with the display and have the ability to be adjusted for alternative mounting methods.
 - d. Shall include lifting supports that can be removed after installation.
 - 3. Exterior Finish
 - a. The LED display border pieces shall be coated with an automotive-grade acrylic urethane paint.
 - 4. Front Face Construction
 - a. To meet the display readability requirements, the front face must be constructed in such a manner that it provides high contrast, low sunlight reflection and durability in all weather and site conditions.
 - b. Minimum features of front face shall:
 - i. Provide UV resistance to prevent discoloring.
 - ii. Include horizontal louvers for contrast enhancement.
 - iii. Include vertical ribbing for contrast enhancement
 - iv. Use surface materials in the active LED area, such as metal, plastic, or other face materials, designed for low sunlight reflectivity.
 - 5. Serviceability
 - a. The display housing shall provide safe and convenient front service access for all modular assemblies, components, wiring, and other materials located within the housing.
 - b. All internal components shall be removable and replaceable by a single technician with basic hand tools.
 - c. Service access shall be easily obtained by removal of one or more modules in front of the associated internal component.
 - d. Each module should allow simple removal with a single latch system.
 - e. Displays shall be designed with service features that minimize potential bodily harm.
- B. DISPLAY COMPONENTS**
- 1. LED display modules shall be constructed for good readability, long life, and ease of service. Each display module shall be constructed as follows:
 - a. Each module within the product family shall be designed with the same physical footprint of 12.48" x 15.59".
 - b. All modules and their components shall be fully encapsulated and sealed to meet IP-67 standards.

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- c. An LED module shall consist of LEDs with all drive electronics mounted on a single Printed Circuit Board (PCB).
 - d. LEDs shall be auto-inserted in order to maintain quality and uniformity of the LEDs within each LED module.
 - e. All PCBs shall be wave-soldered to ensure uniformity, quality, and durability of all solder joints.
 - f. All PCBs shall be cleaned in a manner so as not to contain more than 2 parts per million contaminants.
 - g. Module signal and electrical connections shall be of the positive locking and removable type. Removal of a module from the display shall not require a de-soldering operation.
 - h. Data to the modules shall be redundant in that the signal can reach the module from multiple directions in the event of a loss in signal path from either direction.
 - i. All LED display modules in a single display shall be identical in construction and interchangeable throughout the display with the ability to be field calibrated.
 - j. All module rows shall include continuous louvers over the LEDs for sunlight shading and enhanced contrast.
 - k. Modules shall be individually attached to the cabinet frame.
 - l. Removal of one or more modules shall not affect the display's structural integrity.
 - m. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 15.85mm both horizontally and vertically.
 - n. The failure of a single pixel, module or power supply shall not cause the failure of any other pixel, module or power supply in the display.
 - o. All modules shall have no less than a 140° horizontal half-intensity viewing angle and a readability angle of 160° horizontal.
 - p. The transition of the viewing intensity shall be consistent throughout the viewing cone.
2. Pixels shall be constructed with discrete LEDs, and these discrete LEDs shall conform to the following specifications:
 - a. LEDs shall be non-diffused, ultra-bright, solid-state light emitting diodes.
 - b. The red LEDs shall be constructed of AlInGaP technology and the green and blue LEDs shall be constructed of InGaN technology.
 - c. Each color of LEDs used in all LED displays provided for this contract shall be from the same bin.
 - d. LED half-life shall be an estimated minimum of 100,000 hours.
 - e. Display shall have a minimum intensity of 10,000 cd/m² for RGB maximum light output, 4,500 cd/m² for Red maximum light output, and 6,000 cd/m² for Amber maximum light output.
 3. Power Supply
 - a. All power supplies shall be regulated, auto-ranging AC to DC power, with protection for the LED pixel, LED display and driver circuitry in the event of power spikes or surges.
 - b. Each power supply and their connectors shall be fully sealed to protect from corrosive environmental factors meeting IP-67 standards.
 4. Internal Wiring

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- a. Wiring for LED display modules and other internal components shall be installed in the housing in a neat and professional manner.
 - b. Wiring shall not impede the removal of display modules, power supplies or other display components.
 - c. Wires shall not make contact with or be bent around sharp metal edges.
 - d. All wiring shall conform to the National Electric Code.
5. The display shall be protected from electrical spikes and transients.
 6. The manufacturer shall provide an earth-ground lug on the display.
- C. DISPLAY PERFORMANCE
1. Display Capability
 - a. The LED display shall present messages that are continuous, uniform, and unbroken in appearance.
 - b. The LED display shall be capable of producing 281 trillion colors for RGB and 4096 shades of color for monochrome red or amber at all dimming levels.
 - c. Each display pixel shall be composed of one each – red, green, and blue LEDs or one red or one amber
 - d. The LED display shall be capable of displaying all true type fonts.
 - e. The display shall be able to display messages composed of any combination of alphanumeric text, punctuation symbols, graphic images, and pre-canned video files.
 - f. Video and message files shall have up to a 30 frame per second playback capability.
 2. Controller
 - a. The display's controller shall be able to run independently from a controlling computing device allowing the display to operate even when the controlling device is unhooked or turned off.
 - b. Communication protocol shall support other matrix products from the vendor such as other outdoor or indoor displays of varying sizes and/or colors.
 - c. Each controller shall be connected to a light sensor allowing each LED display to automatically adjust brightness according to display direction and lighting conditions.
 - d. The controller shall allow connection to a temperature sensor that provides accurate site temperatures.
 - e. Active presentations, stored presentations, schedules, display configuration, time and date shall be stored in non-volatile memory. No external power or battery backup will be required to maintain this data.
 3. Control and Communications
 - a. The display controller should be DHCP-enabled and allow for static IP addressing.
 - b. Each single-face display shall be controlled and monitored by its own LED controller.
 - c. The LED controller shall be able to receive instructions from and provide information by accessing the Venus Control Suite using the following communication modes:

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- Select one only:
- Ethernet Cellular Modem

D. CONTROL SOFTWARE

1. Control Software: Display content and scheduling shall be via Venus Control Suite (VCS) cloud-based solution. Software to be hosted on manufacturer's servers at no cost to the customer. Web browser access to the solution to support iOS Safari, Android Chrome, Internet Explorer v11+, Microsoft Edge, Google Chrome and Mozilla Firefox.
2. Basic content creation to be performed via browser-based online editor.
3. Expanded content creation tools available via PC-compatible Content Studio download.
4. Supports import of images (PNG, BMP, GIF, JPG, PSD) and video files (AVI, MPG, MP4, MOV) in both browser-based and downloadable content utilities.
5. Sign to be added to existing customer VCS account.

2.02 POLE MOUNTED THREE VIEW DISPLAY –ALTERNATE

A. LED Display

1. Cabinet Construction
 - a. Cabinet dimensions 4' 2" H X 9' 11" W X 0' 7" D The front-to-back cabinet depth shall not exceed 7 inches.
 - b. The cabinet shall contain a full LED matrix measuring a minimum of 108 pixel rows high by 288 pixel columns wide.
 - c. Cabinet display configuration is:
 - i. Three-Faces (3V), three sided display
 - d. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 10.16 mm both horizontally and vertically.
 - e. Maximum display power per face shall not exceed 2510 watts when 100% of the pixels are operating at their maximum possible drive current.
 - f. Cabinet weight per face shall not exceed 365 lbs
 - g. Display shall operate from the following power sources: 120/240 VAC, 60 Hz single-phase, including neutral and earth ground.
 - h. Display shall operate in a minimum ambient temperature range of -40° to +120°F (-40 to +50°C) and to a 95% humidity.
 - i. Internal display component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from stainless steel, aluminum, nylon, or other durable corrosion-resistant materials suitable for the signage application.
 - j. Electrical display components shall be 100% solid-state.
 - k. The presence of ambient radio signals and magnetic or electromagnetic interference, including those from power lines, transformers, and motors, shall not impair performance of the display system.
 - l. Housing Frame
2. Display materials shall use non-corrosive materials or have a protective coating so they shall be anti-corrosive and not degrade or oxidize.
3. The display shall be rear ventilated with adequate ventilation provided by the use of fans.

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4. Steel mounting points that can be used for mounting purposes shall be provided with the display and have the ability to be adjusted for alternative mounting methods.
 5. Shall include lifting supports that can be removed after installation.
 6. Exterior Finish
 - a. The LED display border pieces shall be coated with an automotive-grade acrylic urethane paint.
 7. Front Face Construction
 - a. To meet the display readability requirements, the front face must be constructed in such a manner that it provides high contrast, low sunlight reflection and durability in all weather and site conditions.
 - b. Minimum features of front face shall:
 - i. Include horizontal louvers for contrast enhancement.
 - ii. Include vertical ribbing for contrast enhancement
 - iii. Use surface materials in the active LED area, such as metal, plastic, or other face materials, designed for low sunlight reflectivity.
 8. Serviceability
 - a. The display housing shall provide safe and convenient front service access for all modular assemblies, components, wiring, and other materials located within the housing.
 - b. All internal components shall be removable and replaceable by a single technician with basic hand tools.
 - c. Service access shall be easily obtained by removal of one or more modules in front of the associated internal component.
 - d. Each module should allow simple removal with a single latch system.
 - e. Displays shall be designed with service features that minimize potential bodily harm.
- B. DISPLAY COMPONENTS**
1. LED display modules shall be constructed for good readability, long life, and ease of service. Each display module shall be constructed as follows:
 - a. Each module within the product family shall be designed with the same physical footprint of 14.4" x 14.4".
 - b. All modules and their components shall be fully encapsulated and sealed to meet IP-67 standards.
 - c. An LED module shall consist of LEDs with all drive electronics mounted on a single Printed Circuit Board (PCB).
 - d. LEDs shall be auto-inserted in order to maintain quality and uniformity of the LEDs within each LED module.
 - e. All PCBs shall be wave-soldered to ensure uniformity, quality, and durability of all solder joints.
 - f. All PCBs shall be cleaned in a manner so as not to contain more than 2 parts per million contaminants.
 - g. Module signal and electrical connections shall be of the positive locking and removable type. Removal of a module from the display shall not require a de-soldering operation.

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- h. Data to the modules shall be redundant in that the signal can reach the module from multiple directions in the event of a loss in signal path from either direction.
 - i. All LED display modules in a single display shall be identical in construction and interchangeable throughout the display with the ability to be field calibrated.
 - j. All module rows shall include continuous louvers over the LEDs for sunlight shading and enhanced contrast.
 - k. Modules shall be individually attached to the cabinet frame.
 - l. Removal of one or more modules shall not affect the display's structural integrity.
 - m. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 10.16 mm both horizontally and vertically.
 - n. The failure of a single pixel, module or power supply shall not cause the failure of any other pixel, module or power supply in the display.
 - o. All modules shall have no less than a 160° horizontal half-intensity viewing angle.
 - p. The transition of viewing intensity shall be consistent throughout the viewing cone.
2. Pixels shall conform to the following specifications:
- a. Surface mount device LEDs shall be mounted to the surface of the circuit board.
 - b. LEDs shall be non-diffused, ultra-bright, solid-state light emitting diodes.
 - c. The red LEDs shall be constructed of AlInGaP technology and the green and blue LEDs shall be constructed of InGaN technology.
 - d. Each color of LEDs used in all LED displays provided for this contract shall be from the same bin.
 - e. LED half-life shall be an estimated minimum of 100,000 hours.
 - f. Display shall have a minimum intensity of 8,000 cd/m² for RGB maximum light output.
3. Power Supply
- a. All power supplies shall be regulated, auto-ranging AC to DC power, with protection for the LED pixel, LED display and driver circuitry in the event of power spikes or surges.
 - b. Each power supply and their connectors shall be fully sealed to protect from corrosive environmental factors meeting IP-67 standards.
4. Internal Wiring
- a. Wiring for LED display modules and other internal components shall be installed in the housing in a neat and professional manner.
 - b. Wiring shall not impede the removal of display modules, power supplies or other display components.
 - c. Wires shall not make contact with or be bent around sharp metal edges.
 - d. All wiring shall conform to the National Electric Code.
5. The display shall be protected from electrical spikes and transients.
6. The manufacturer shall provide an earth-ground lug on the display.

C. DISPLAY PERFORMANCE

1. Display Capability

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- a. The LED display shall present messages that are continuous, uniform, and unbroken in appearance.
 - b. The LED display shall be capable of producing 281 trillion colors for RGB at all dimming levels.
 - c. Each display pixel shall be composed of one surface mount LED containing one each – red, green, and blue LED within a single package.
 - d. The LED display shall be capable of displaying all true type fonts.
 - e. The display shall be able to display messages composed of any combination of alphanumeric text, punctuation symbols, graphic images, and pre-canned video files.
 - f. Video and message files shall have up to a 30 frame per second playback capability.
2. Controller
 - a. The display's controller shall be able to run independently from a controlling computing device allowing the display to operate even when the controlling device is unhooked or turned off.
 - b. Communication protocol shall support other matrix products from the vendor such as other outdoor or indoor displays of varying sizes and/or colors.
 - c. Each controller shall be connected to a light sensor allowing each LED display to automatically adjust brightness according to display direction and lighting conditions.
 - d. The controller shall allow connection to a temperature sensor that provides accurate site temperatures.
 - e. Active presentations, stored presentations, schedules, display configuration, time and date shall be stored in non-volatile memory. No external power or battery backup will be required to maintain this data.
 3. Control and Communications
 - a. The display controller should be DHCP-enabled and allow for static IP addressing.
 - b. Each single face display shall be controller and monitored by its own embedded LED controller. Each 2V display shall be controlled and monitored by one sign controller in the primary face, and the secondary face must show the same mirrored content.
 - c. The LED controller shall be able to receive instructions from and provide information by accessing the Venus Control Suite using the following communication modes:
 - d. Ethernet
- D. CONTROL SOFTWARE
1. Control Software: Display content and scheduling shall be via Venus Control Suite (VCS) cloud-based solution. Software to be hosted on manufacturer's servers at no cost to the customer. Web browser access to the solution to support iOS Safari, Android Chrome, Internet Explorer v11+, Microsoft Edge, Google Chrome and Mozilla Firefox.
 2. Basic content creation to be performed via browser-based online editor.
 3. Expanded content creation tools available via PC-compatible Content Studio download.

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4. Supports import of images (PNG, BMP, GIF, JPG, PSD) and video files (AVI, MPG, MP4, MOV) in both browser-based and downloadable content utilities.

2.03 WALL MOUNTED SINGLE FACE DISPLAY - BASE BID

A. LED Display

1. Cabinet Construction

- a. Cabinet dimensions 3' 8" H X 9' 5" W X 0' 5" D. The front-to-back cabinet depth shall not exceed 12 inches.
- b. The cabinet shall contain a full LED matrix measuring a minimum of 60 pixel rows high by 175 pixel columns wide.
- c. Cabinet display configuration is:
- d. Single-Face (SF), one sided display
- e. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 15.85mm both horizontally and vertically.
- f. Maximum display power per face shall not exceed 1050 watts when 100% of the pixels are operating at their maximum possible drive current.
- g. Cabinet weight per face shall not exceed 245 lbs.
- h. Display shall operate from the following power sources: 120/240 VAC, 60 Hz single-phase, including neutral and earth ground.
- i. Display shall operate in a minimum ambient temperature range of -40° to +120°F (-40 to +50°C) and to a 95% humidity.
- j. Internal display component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from stainless steel, aluminum, nylon, or other durable corrosion-resistant materials suitable for the signage application.
- k. Electrical display components shall be 100% solid-state.
- l. The presence of ambient radio signals and magnetic or electromagnetic interference, including those from power lines, transformers, and motors, shall not impair performance of the display system.

2. Housing Frame

- a. Display materials shall use non-corrosive materials or have a protective coating so they shall be anti-corrosive and not degrade or oxidize.
- b. The display shall be rear ventilated with adequate ventilation provided by the use of fans.
- c. Steel mounting points that can be used for mounting purposes shall be provided with the display and have the ability to be adjusted for alternative mounting methods.
- d. Shall include lifting supports that can be removed after installation.

3. Exterior Finish

- a. The LED display border pieces shall be coated with an automotive-grade acrylic urethane paint.

4. Front Face Construction

- a. To meet the display readability requirements, the front face must be constructed in such a manner that it provides high contrast, low sunlight reflection and durability in all weather and site conditions.
- b. Minimum features of front face shall:

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- i. Provide UV resistance to prevent discoloring.
- ii. Include horizontal louvers for contrast enhancement.
- iii. Include vertical ribbing for contrast enhancement
- iv. Use surface materials in the active LED area, such as metal, plastic, or other face materials, designed for low sunlight reflectivity.

5. Serviceability

- a. The display housing shall provide safe and convenient front service access for all modular assemblies, components, wiring, and other materials located within the housing.
- b. All internal components shall be removable and replaceable by a single technician with basic hand tools.
- c. Service access shall be easily obtained by removal of one or more modules in front of the associated internal component.
- d. Each module should allow simple removal with a single latch system.
- e. Displays shall be designed with service features that minimize potential bodily harm.

B. DISPLAY COMPONENTS

1. LED display modules shall be constructed for good readability, long life, and ease of service. Each display module shall be constructed as follows:
 - a. Each module within the product family shall be designed with the same physical footprint of 12.48" x 15.59".
 - b. All modules and their components shall be fully encapsulated and sealed to meet IP-67 standards.
 - c. An LED module shall consist of LEDs with all drive electronics mounted on a single Printed Circuit Board (PCB).
 - d. LEDs shall be auto-inserted in order to maintain quality and uniformity of the LEDs within each LED module.
 - e. All PCBs shall be wave-soldered to ensure uniformity, quality, and durability of all solder joints.
 - f. All PCBs shall be cleaned in a manner so as not to contain more than 2 parts per million contaminants.
 - g. Module signal and electrical connections shall be of the positive locking and removable type. Removal of a module from the display shall not require a de-soldering operation.
 - h. Data to the modules shall be redundant in that the signal can reach the module from multiple directions in the event of a loss in signal path from either direction.
 - i. All LED display modules in a single display shall be identical in construction and interchangeable throughout the display with the ability to be field calibrated.
 - j. All module rows shall include continuous louvers over the LEDs for sunlight shading and enhanced contrast.
 - k. Modules shall be individually attached to the cabinet frame.
 - l. Removal of one or more modules shall not affect the display's structural integrity.
 - m. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 15.85mm both horizontally and vertically.

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- n. The failure of a single pixel, module or power supply shall not cause the failure of any other pixel, module or power supply in the display.
 - o. All modules shall have no less than a 140° horizontal half-intensity viewing angle and a readability angle of 160° horizontal.
 - p. The transition of the viewing intensity shall be consistent throughout the viewing cone.
2. Pixels shall be constructed with discrete LEDs, and these discrete LEDs shall conform to the following specifications:
 - a. LEDs shall be non-diffused, ultra-bright, solid-state light emitting diodes.
 - b. The red LEDs shall be constructed of AlInGaP technology and the green and blue LEDs shall be constructed of InGaN technology.
 - c. Each color of LEDs used in all LED displays provided for this contract shall be from the same bin.
 - d. LED half-life shall be an estimated minimum of 100,000 hours.
 - e. Display shall have a minimum intensity of 10,000 cd/m² for RGB maximum light output, 4,500 cd/m² for Red maximum light output, and 6,000 cd/m² for Amber maximum light output.
 3. Power Supply
 - a. All power supplies shall be regulated, auto-ranging AC to DC power, with protection for the LED pixel, LED display and driver circuitry in the event of power spikes or surges.
 - b. Each power supply and their connectors shall be fully sealed to protect from corrosive environmental factors meeting IP-67 standards.
 4. Internal Wiring
 - a. Wiring for LED display modules and other internal components shall be installed in the housing in a neat and professional manner.
 - b. Wiring shall not impede the removal of display modules, power supplies or other display components.
 - c. Wires shall not make contact with or be bent around sharp metal edges.
 - d. All wiring shall conform to the National Electric Code.
 5. The display shall be protected from electrical spikes and transients.
 6. The manufacturer shall provide an earth-ground lug on the display.

C. DISPLAY PERFORMANCE

1. Display Capability
 - a. The LED display shall present messages that are continuous, uniform, and unbroken in appearance.
 - b. The LED display shall be capable of producing 281 trillion colors for RGB and 4096 shades of color for monochrome red or amber at all dimming levels.
 - c. Each display pixel shall be composed of one each – red, green, and blue LEDs or one red or one amber
 - d. The LED display shall be capable of displaying all true type fonts.
 - e. The display shall be able to display messages composed of any combination of alphanumeric text, punctuation symbols, graphic images, and pre-canned video files.

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- f. Video and message files shall have up to a 30 frame per second playback capability.
 2. Controller
 - a. The display's controller shall be able to run independently from a controlling computing device allowing the display to operate even when the controlling device is unhooked or turned off.
 - b. Communication protocol shall support other matrix products from the vendor such as other outdoor or indoor displays of varying sizes and/or colors.
 - c. Each controller shall be connected to a light sensor allowing each LED display to automatically adjust brightness according to display direction and lighting conditions.
 - d. The controller shall allow connection to a temperature sensor that provides accurate site temperatures.
 - e. Active presentations, stored presentations, schedules, display configuration, time and date shall be stored in non-volatile memory. No external power or battery backup will be required to maintain this data.
 3. Control and Communications
 - a. The display controller should be DHCP-enabled and allow for static IP addressing.
 - b. Each single-face display shall be controlled and monitored by its own LED controller.
 - c. The LED controller shall be able to receive instructions from and provide information by accessing the Venus Control Suite using the following communication modes:
 - Select one only:
 - Ethernet Cellular Modem
- D. CONTROL SOFTWARE
1. Control Software: Display content and scheduling shall be via Venus Control Suite (VCS) cloud-based solution. Software to be hosted on manufacturer's servers at no cost to the customer. Web browser access to the solution to support iOS Safari, Android Chrome, Internet Explorer v11+, Microsoft Edge, Google Chrome and Mozilla Firefox.
 2. Basic content creation to be performed via browser-based online editor.
 3. Expanded content creation tools available via PC-compatible Content Studio download.
 4. Supports import of images (PNG, BMP, GIF, JPG, PSD) and video files (AVI, MPG, MP4, MOV) in both browser-based and downloadable content utilities.
 5. Sign to be added to existing customer VCS account.

2.04 WALL MOUNTED SINGLE FACE DISPLAY –ALTERNATE

- A. LED Display
 1. Cabinet Construction
 - a. Cabinet dimensions 4' 2" H X 9' 11" W X 0' 7" D The front-to-back cabinet depth shall not exceed 7 inches.
 - b. The cabinet shall contain a full LED matrix measuring a minimum of 108 pixel rows high by 288 pixel columns wide.

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- c. Cabinet display configuration is:
 - d. [Single-Face (SF), one sided display]
 - e. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 10.16 mm both horizontally and vertically.
 - f. Maximum display power per face shall not exceed 2510 watts when 100% of the pixels are operating at their maximum possible drive current.
 - g. Cabinet weight per face shall not exceed 365 lbs
 - h. Display shall operate from the following power sources: 120/240 VAC, 60 Hz single-phase, including neutral and earth ground.
 - i. Display shall operate in a minimum ambient temperature range of -40° to +120°F (-40 to +50°C) and to a 95% humidity.
 - j. Internal display component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from stainless steel, aluminum, nylon, or other durable corrosion-resistant materials suitable for the signage application.
 - k. Electrical display components shall be 100% solid-state.
 - l. The presence of ambient radio signals and magnetic or electromagnetic interference, including those from power lines, transformers, and motors, shall not impair performance of the display system.
2. Housing Frame
 3. Display materials shall use non-corrosive materials or have a protective coating so they shall be anti-corrosive and not degrade or oxidize.
 4. The display shall be rear ventilated with adequate ventilation provided by the use of fans.
 5. Steel mounting points that can be used for mounting purposes shall be provided with the display and have the ability to be adjusted for alternative mounting methods.
 6. Shall include lifting supports that can be removed after installation.
 7. Exterior Finish
 - a. The LED display border pieces shall be coated with an automotive-grade acrylic urethane paint.
 8. Front Face Construction
 - a. To meet the display readability requirements, the front face must be constructed in such a manner that it provides high contrast, low sunlight reflection and durability in all weather and site conditions.
 - b. Minimum features of front face shall:
 - iii. Include horizontal louvers for contrast enhancement.
 - iv. Include vertical ribbing for contrast enhancement
 - v. Use surface materials in the active LED area, such as metal, plastic, or other face materials, designed for low sunlight reflectivity.
 9. Serviceability
 - a. The display housing shall provide safe and convenient front service access for all modular assemblies, components, wiring, and other materials located within the housing.
 - b. All internal components shall be removable and replaceable by a single technician with basic hand tools.

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- c. Service access shall be easily obtained by removal of one or more modules in front of the associated internal component.
- d. Each module should allow simple removal with a single latch system.
- e. Displays shall be designed with service features that minimize potential bodily harm.

B. DISPLAY COMPONENTS

1. LED display modules shall be constructed for good readability, long life, and ease of service. Each display module shall be constructed as follows:
 - a. Each module within the product family shall be designed with the same physical footprint of 14.4" x 14.4".
 - b. All modules and their components shall be fully encapsulated and sealed to meet IP-67 standards.
 - c. An LED module shall consist of LEDs with all drive electronics mounted on a single Printed Circuit Board (PCB).
 - d. LEDs shall be auto-inserted in order to maintain quality and uniformity of the LEDs within each LED module.
 - e. All PCBs shall be wave-soldered to ensure uniformity, quality, and durability of all solder joints.
 - f. All PCBs shall be cleaned in a manner so as not to contain more than 2 parts per million contaminants.
 - g. Module signal and electrical connections shall be of the positive locking and removable type. Removal of a module from the display shall not require a de-soldering operation.
 - h. Data to the modules shall be redundant in that the signal can reach the module from multiple directions in the event of a loss in signal path from either direction.
 - i. All LED display modules in a single display shall be identical in construction and interchangeable throughout the display with the ability to be field calibrated.
 - j. All module rows shall include continuous louvers over the LEDs for sunlight shading and enhanced contrast.
 - k. Modules shall be individually attached to the cabinet frame.
 - l. Removal of one or more modules shall not affect the display's structural integrity.
 - m. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 10.16 mm both horizontally and vertically.
 - n. The failure of a single pixel, module or power supply shall not cause the failure of any other pixel, module or power supply in the display.
 - o. All modules shall have no less than a 160° horizontal half-intensity viewing angle.
 - p. The transition of viewing intensity shall be consistent throughout the viewing cone.
2. Pixels shall conform to the following specifications:
 - a. Surface mount device LEDs shall be mounted to the surface of the circuit board.
 - b. LEDs shall be non-diffused, ultra-bright, solid-state light emitting diodes.
 - c. The red LEDs shall be constructed of AlInGaP technology and the green and blue LEDs shall be constructed of InGaN technology.

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- d. Each color of LEDs used in all LED displays provided for this contract shall be from the same bin.
 - e. LED half-life shall be an estimated minimum of 100,000 hours.
 - f. Display shall have a minimum intensity of 8,000 cd/m² for RGB maximum light output.
3. Power Supply
- a. All power supplies shall be regulated, auto-ranging AC to DC power, with protection for the LED pixel, LED display and driver circuitry in the event of power spikes or surges.
 - b. Each power supply and their connectors shall be fully sealed to protect from corrosive environmental factors meeting IP-67 standards.
4. Internal Wiring
- a. Wiring for LED display modules and other internal components shall be installed in the housing in a neat and professional manner.
 - b. Wiring shall not impede the removal of display modules, power supplies or other display components.
 - c. Wires shall not make contact with or be bent around sharp metal edges.
 - d. All wiring shall conform to the National Electric Code.
 - e. The display shall be protected from electrical spikes and transients.
 - f. The manufacturer shall provide an earth-ground lug on the display.
- C. DISPLAY PERFORMANCE
5. Display Capability
- a. The LED display shall present messages that are continuous, uniform, and unbroken in appearance.
 - b. The LED display shall be capable of producing 281 trillion colors for RGB at all dimming levels.
 - c. Each display pixel shall be composed of one surface mount LED containing one each – red, green, and blue LED within a single package.
 - d. The LED display shall be capable of displaying all true type fonts.
 - e. The display shall be able to display messages composed of any combination of alphanumeric text, punctuation symbols, graphic images, and pre-canned video files.
 - f. Video and message files shall have up to a 30 frame per second playback capability.
6. Controller
- a. The display's controller shall be able to run independently from a controlling computing device allowing the display to operate even when the controlling device is unhooked or turned off.
 - b. Communication protocol shall support other matrix products from the vendor such as other outdoor or indoor displays of varying sizes and/or colors.
 - c. Each controller shall be connected to a light sensor allowing each LED display to automatically adjust brightness according to display direction and lighting conditions.

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- d. The controller shall allow connection to a temperature sensor that provides accurate site temperatures.
- e. Active presentations, stored presentations, schedules, display configuration, time and date shall be stored in non-volatile memory. No external power or battery backup will be required to maintain this data.

7. Control and Communications

- a. The display controller should be DHCP-enabled and allow for static IP addressing.
- b. Each single face display shall be controller and monitored by its own embedded LED controller. Each 2V display shall be controlled and monitored by one sign controller in the primary face, and the secondary face must show the same mirrored content.
- c. The LED controller shall be able to receive instructions from and provide information by accessing the Venus Control Suite using the following communication modes:
 - i. Ethernet

D. CONTROL SOFTWARE

- 1. Control Software: Display content and scheduling shall be via Venus Control Suite (VCS) cloud-based solution. Software to be hosted on manufacturer's servers at no cost to the customer. Web browser access to the solution to support iOS Safari, Android Chrome, Internet Explorer v11+, Microsoft Edge, Google Chrome and Mozilla Firefox.
- 2. Basic content creation to be performed via browser-based online editor.
- 3. Expanded content creation tools available via PC-compatible Content Studio download.
- 4. Supports import of images (PNG, BMP, GIF, JPG, PSD) and video files (AVI, MPG, MP4, MOV) in both browser-based and downloadable content utilities.

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PART 3 EXECUTION

3.01 EXAMINATION

- A. Mounting structure to be installed by contractor to support desired displays in all locations. Verify that separate conduit is in place for power and data to display, unless fiber is being used. Verify that all control equipment has access to 120 VAC.

3.02 FABRICATION

- A. All internal wiring shall be factory completed. All wiring shall be in harnesses and bound. No loose or randomly routed wires shall be permitted.
- B. All wire sizes and insulations shall comply with NFPA 70 National Electric Code (NEC), UL, and local codes and meet or exceed electronics industry standards.

3.03 PACKING AND SHIPPING

- A. Equipment shall be wrapped and sealed in polyethylene and substantially crated for shipment. Crates shall clearly indicate equipment contained, nature of components, and site designation.
- B. The equipment manufacturer shall provide notice prior to shipping of shipping method and equipment contained.

3.04 INSTALLATION

- A. New display must mount in existing enclosure. Contractor to survey existing enclosure prior to issuing submittal. Contractor is responsible for any new mounting and to verify the structural integrity of existing enclosure and hardware. Support structure design depends on the mounting methods, display size, and weight. The structure design is critical and should be done only by a qualified individual. It is the manufacturer's responsibility to ensure that the structure and mounting hardware are adequate.
- B. The mounting hardware shall be capable of supporting all components to be mounted.
- C. All mounted displays must be inspected by a qualified structural engineer.
- D. Possible power and signal entrances are designated by etched markings. Separate conduit must be used to route the power, signal in wires, and signal out wires.
- E. Displays must be grounded according to the provisions outlined in Article 250 of the National Electrical Code. The display must be connected to earth-ground. Proper grounding is necessary for reliable equipment operation and protects the equipment from damaging electrical disturbances and lightning.
- F. Upon the completion of the work of this Section, dispose of all packing materials, debris and remnants which result from the work of this Section.

END OF SECTION

SECTION 11 61 33 – THEATRE RIGGING, CURTAINS AND TRACKS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SCOPE

- A. All materials, components, and services necessary to provide a complete system indicated in this Section, as specified herein and shown on related Drawings, including:
 - 1. Verification of dimensions and conditions at the job site.
 - 2. Preparation and submission of complete shop drawings and samples for approval prior to fabrication.
 - 3. Shipment of equipment to job site and the secured storage of all non-fixed equipment.
 - 4. Installation and completion, in accordance with these Specifications, related Drawings, the Equipment Manufacturer's recommendations, established trade criteria, and all applicable code requirements.
 - 5. The inspection, demonstration, and necessary adjustment of the completed installation by the Contractor's engineering personnel.
 - 6. Preparation and submission of complete record drawings and operational and maintenance data and certificates.

1.03 WORK INCLUDED

- A. Motorized winches and winch controls.
- B. The above is for reference only and is not intended to define the limits of the work for a complete installation.

1.04 WORK NOT INCLUDED

- A. Principal structural steel work, except as herein indicated.
- B. Electrical wiring, conduit, and connections.
- C. The above is for reference only and is not intended to define the limits of the work for a complete installation.

1.05 RELATED WORK IN OTHER SECTIONS

- A. General electrical work.
- B. Sound and communications systems.
- C. Section 26 09 61 – Theatrical lighting system.

1.06 QUALIFICATIONS

- A. All equipment and installation shall be the responsibility of a single contractor who shall own and operate his own full-time, staffed shop and sewing room for the fabrication and assembly of stage equipment. This contractor shall assume complete responsibility for the engineering, fabrication, transportation, and installation of the work in this Section, and shall hold the Owner, Architect, Schuler Shook, and all their Employees and Consultants harmless for any costs for errors

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or omissions associated with the work of this Section and any action arising therefrom.

- B. Approved contractors may, at their option, arrange for sub-contract field and special shop work to be done by others. Bid submissions must identify such subcontractors and indicate the work they are to do.
- C. The contractor shall have at least ten (10) years' experience in the installation of similar equipment and systems. If requested, the contractor shall submit a representative list of installations during the above period.
- D. Other contractors may be considered with the prior review of Schuler Shook. Contractors seeking approval to bid must contact Schuler Shook and provide the following information not less than ten (10) days prior to the bid date:
 - 1. List of projects of similar scale and complexity completed in the last five (5) years. Provide project name, location, completion date, and description of equipment installed. Provide contact name, title and phone number for references familiar with contractor's work on each project listed.
 - 2. Samples of shop drawing submittals for projects of similar scale and complexity completed in the last five (5) years.
 - 3. Technical data sheets for any product proposed for use on this project.
 - 4. Samples of any products requested by Schuler Shook.
 - 5. Name, resume and number of years of employment for contractor's Project Manager assigned to this project.

1.07 SUBMITTALS

- A. Ten (10) days prior to bid.
 - 1. A list of any and all proposed deviations or exceptions from the contract Drawings and Specifications. Any deviations or exceptions from the Drawings or Specifications proposed after this time shall not be accepted.
- B. With bid.
 - 1. Proof of qualifications as listed above.
 - 2. A list of any and all formally pre-approved deviations or exceptions from the contract Drawings and Specifications. Any deviations or exceptions from the Drawings or Specifications proposed after bid shall not be accepted.
 - 3. A schedule for the anticipated completion of the following:
 - a. Shop drawings.
 - b. Delivery of all equipment.
 - c. Installation of all systems.
- C. Shop drawings.
 - 1. Shop drawings shall be produced by the primary rigging equipment manufacturer. Where multiple manufacturers are providing equipment, the rigging contractor shall assemble all shop drawing submittals into a single, complete package with internal coordination. Shop drawings produced by an equipment dealer / vendor shall not be accepted. Partial shop drawing submittals shall not be accepted.
 - 2. Prepare all shop drawings under the supervision of professional electrical and structural engineers so licensed by the State of Oklahoma. All shop drawings shall be stamped and certified by those engineers. Structural

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Engineer's review shall include, but not be limited to, all elements related to overhead lifting, all elements suspended overhead, and structural support of all elements provided by the Rigging Contractor.

3. Within thirty (30) days of contract award, the Contractor shall submit one (1) complete set of computer-generated drawings in PDF format to the Architect for approval prior to fabrication:
 - a. Floor plan and section of stage in scale equal to 1/4" = 1'-0".
 - b. Complete, fully dimensioned shop drawings of all major components.
 - c. Requisite plans, sections, schematics, and details indicating assembly and installation of components.
 - d. Quantities of each component and sub-assembly.
 - e. Load ratings of all bearings, blocks, trim chains, lift lines, and purchase lines within the system.
 - f. Certification that all steel cable and rope is certified to meet Federal Standard RR-W-410E or ASTM 1023/A 1023M and to meet the required breaking strength.
 - g. Indication of all supplementary structural support to be supplied and installed as part of the work of this Section.
 - h. Complete descriptions, including manufacturer and model number, of all bearings, motors, and transmissions.
 - i. Complete descriptions, including manufacturer and model number, of all electrical components. All control panel switches and pilot lights shall be described by the manufacturer's catalog sheet.
 - j. Power requirements and installation wiring diagrams for all electrical components.
 - k. Indication by boxed caption of any and all deviations or exceptions from the contract Drawings and Specifications, whether or not these variations have been formally or informally accepted by Schuler Shook.
- D. Final submittal.
1. Within thirty (30) days of final tests, and as a condition for final approval, the Contractor shall submit three (3) bound sets to the Architect and one (1) bound set to Schuler Shook:
 - a. Receipts for delivery of all non-installed items, i.e., all items designated, "deliver to Owner."
 - b. "As built and approved" drawings and wiring diagrams showing all systems and components as installed, including all field modifications.
 - c. Operation and service manuals, schematics, and parts lists for each unit of equipment installed or provided.
 - d. Flameproofing certificates.
 - e. Load testing record.
 - f. Certificates of warranty, as set forth below.

1.08 TESTING AND INSTRUCTION

- A. The primary rigging equipment manufacturer shall conduct a preliminary site inspection and notify Schuler Shook in writing that the installation is complete and

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ready for punch list inspection. The manufacturer site inspection may be waived in writing by Schuler Shook prior to bid.

- B. Upon completion of all installation work and manufacturer inspection, the Contractor shall certify in writing to the Architect that the work is complete and ready for final inspection. Final inspection shall be scheduled by the Owner, the Architect, and Schuler Shook within fourteen (14) days following the Contractor's notice of completion.
- C. Final inspection shall be conducted by a knowledgeable representative of the Contractor, in the presence of the Owner, the Architect, and Schuler Shook, and shall include the following:
 - 1. Visual examination of all components.
 - 2. Operation of all components.
 - 3. Sightline check of masking curtains.
 - 4. Full failure condition test of all safety brakes.
- D. Necessary adjustments or modifications shall be made as required.
- E. Contractor's representative shall instruct Owner's designated staff or representatives in the safe operation and maintenance of all equipment, including the storage and cleaning of all fabrics. This instruction session shall be scheduled to last a minimum of four (4) hours.
- F. The contractor shall provide to the Owner video-recorded instructions on the operation and maintenance of the system. Information contained in the video shall include all points of operation and maintenance covered in the instruction session with the Owner's staff. A recording of the actual instruction session is acceptable. Provide two (2) DVDs each containing full copies of the video instruction.

1.09 GENERAL REQUIREMENTS

- A. General Conditions of the project contract, work schedules, and site regulations apply to this work.
- B. This work shall comply with local codes and applicable NEC and UL standards, and all components shall carry pertinent UL labels.
- C. Equipment shall comply with applicable UL standards including:
 - 1. UL 508A Industrial control panels.
 - 2. UL 924 Emergency lighting and power equipment.
 - 3. UL 1640 Portable power distribution equipment.
- D. All equipment shall be fully insured against loss or damage during shipment, job site storage, installation, and testing. The Contractor shall have and assume full responsibility for the safety of every unit of equipment, components, wiring, and plans during delivery, installation, and testing. Certification of such coverage shall be furnished to the Architect within 30 days of award of contract.
- E. Warranty.
 - 1. The Contractor shall unconditionally warrant all equipment and systems provided under this Section to be free from defects in materials and workmanship for a period of at least twelve (12) months from the date of final acceptance of all work of this Section.

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2. All repairs and service during the warranty period shall be performed at the job site. Labor, materials, and transportation of replacement materials, parts and service personnel to and from the job site shall be included hereunder at the Contractor's expense.
3. Appropriate additional equipment or draperies to replace equipment, devices, or draperies removed for repair, service, or cleaning shall be provided at the job site at no expense to the Owner.
4. Warranty service shall be performed by personnel in the employ of the Contractor and shall not be sub-contracted or assigned to another company, service, or individual unless the Owner has approved such assignment in writing, in which event the Contractor shall nevertheless be responsible to the Owner for such work.

PART 2 PRODUCTS

2.01 GENERAL

- A. All components shall be new and of first quality.
- B. Machinery and component parts shall comply with all applicable tests, ratings, specifications, and code requirements and bear appropriate labels of conformity and acceptability.
- C. All components shall bear pertinent flameproofing certificates and UL labels. All components shall bear labels identifying the manufacturer, model number, and serial number. All such labels and certificates shall be permanently attached in a conspicuous location.
- D. Operating parts of all equipment shall be machine finished, and tolerances, finishes, fit, etc., where not specified, shall conform to good trade practices.
- E. All items necessary for a complete, operational system shall be provided, including bolts, nuts, washers, fittings, anchors, supports, hinges, and all other items required for completeness and operational safety. Where not specified elsewhere in this Section, all bolts shall be Grade 5 or better.
- F. Where not specified elsewhere in this Section, all rope and wire rope shall be selected using a minimum safety factor of 8 to 1. All chain, shackles, and all other hardware shall be selected using a minimum safety factor of 3 to 1. These safety factors apply to dynamic loading conditions.
- G. Where not specified elsewhere in this Section, sheaves and drums shall have a tread diameter of at least 30 times the diameter of the wire rope employed.
- H. Unless specifically shown otherwise in the drawings, the contractor shall run all lift lines directly from the winch to the loftblocks without muling. Contractors wishing to add muling may do so only with the approval of Schuler Shook, such proposals to be made at least ten (10) days prior to bid date. Muling to accommodate unforeseen site conditions must be approved by Schuler Shook prior to installation.
- I. Contractor is responsible for all supplemental structure.
- J. Coordinate all lift line and supplemental structure locations with A/V contractor.
- K. All control panel faceplates shall be black anodized aluminum or black painted steel, and all labels and legends shall be permanently engraved directly into the faceplate. Engravings shall be filled with white enamel. Lamicaid labels may be

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used if mechanically fastened. Dry transfer, decals, plastic "dymo," or other types of adhesive labels shall not be used. Silk-screened legends shall not be used. All control panel faceplates shall have beveled edges and rounded corners.

- L. Where specification allows for "approved equal," substitutions shall be proposed to Schuler Shook at least ten (10) days prior to bid date.
 - M. Equipment and hardware are specified on the basis of performance and minimum acceptable quality. Materials manufactured by any of the following companies that equals or surpasses the performance and quality specified will be acceptable:
 - 1. Automatic Devices Company, Allentown, Pennsylvania.
 - 2. J. R. Clancy, Syracuse, New York.
 - 3. H & H Specialties, South El Monte, California.
 - 4. I. Weiss Theatrical Solutions, Fairview, NJ.
 - 5. Stagecraft Industries, Portland, Oregon.
 - 6. Texas Scenic, San Antonio, Texas.
 - 7. Thern, Winona, Minnesota.
 - N. Imported steel cable and rope shall be tested and certified as specified herein. Cable or rope provided by any of the following vendors that equals or surpasses the performance and quality specified will be acceptable. Other vendors seeking approval to provide imported cable or rope must contact Schuler Shook not later than ten (10) days prior to bid date.
 - 1. J. R. Clancy, Syracuse, New York.
 - 2. H & H Specialties, South El Monte, California.
 - 3. I. Weiss Theatrical Solutions, Fairview, NJ.
 - 4. Stagecraft Industries, Portland, Oregon.
 - 5. Texas Scenic, San Antonio, Texas.
 - 6. Thern, Winona, Minnesota.
- 2.02 8-INCH UNDERHUNG LOFT BLOCKS
- A. Sheaves shall have an outside diameter of at least 8 inches, made of Class 30 gray iron conforming to ASTM specification A-48. Sheaves shall be grooved for 1/4" wire rope, with a groove diameter clearance of .015 inch.
 - B. Hubs shall be min. 2" diameter, machine faced, bored for and press-fitted with double sealed precision ball bearing assemblies. Each bearing shall be designed for a dynamic radial loading of at least 1,000 pounds at 500 rpm.
 - C. Shafts shall be min. 1/2 inch diameter cold finished steel shafting. One end shall be locked to the side plate by a keeper pin; the other end shall be threaded and drilled for a castellated lock nut and cotter pin.
 - D. Side plates shall be min. 12 gauge cold rolled steel plate, flame cut to latch over one-half of structural member bottom flange. Side plates shall be attached by at least five (5) min. 5/16" bolts through ungrooved pipe spacers sized to space side plates for proper sheave clearance. Locate spacers where appropriate to retain cables in sheave grooves.
 - E. Locking adjustment shall be high-tensile cast iron angle clip on min. 3/4" threaded rod with two (2) nuts to lock in place OR notched side plates and 3/4" draw bolt with steel clip.

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- F. Basis of design for blocks shall be Clancy 200-40855C25.
- G. Attachment, location and quantity as shown in the Drawings. Coordinate with A/V Contractor.

2.03 STEEL CABLE

- A. All steel cable shall be certified to meet Federal Standard RR-W-410E or ASTM 1023/A 1023M and to meet the required breaking strength. Imported steel cable will only be accepted if provided by a vendor pre-approved in article 2.01.M above.
- B. Counterweight set lift lines. 7 x 19 pre-formed galvanized aircraft cable of right regular lay. Cables larger than 3/8" diameter are permitted to be of 6x37 XIPS construction. Minimum breaking strength shall be not less than indicated below:

Cable Diameter	Minimum Breaking Strength
3/16"	4,200 lbs.
1/4"	7,000 lbs.
5/16"	9,800 lbs.
3/8"	14,400 lbs.
7/16"	17,600 lbs.
1/2"	22,800 lbs.

- C. All wire rope connections shall employ thimbles of the proper size and compressed oval sleeve fittings as manufactured by National Telephone ("Nicopress"). All fittings shall be malleable copper. Aluminum fittings shall not be acceptable. All connections shall be selected and installed to develop the full tensile strength of the cable. Contractor shall maintain and inspect all swaging equipment on a daily basis to ensure the integrity of swaged fittings.
- D. Drop-forged steel cable clips may be used only in specific locations as directed by this Specification, or in locations approved in advance in writing by Schuler Shook or the Owner. Clips shall meet or exceed Federal Specification FF-C-450 and shall produce a termination equal to at least 80% of the breaking strength of the wire rope. The saddles of the clips shall be in contact with the load end of the rope. One clip shall be tight against the thimble to retain the cable in the thimble. Quantity of the clips shall be according to the following:

Cable Diameter	Quantity of Clips
3/16"	2
1/4"	2
5/16"	2
3/8"	2
7/16"	2
1/2"	3

- E. Sizes and connections per Drawings and Schedules.

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2.04 MOTORIZED DRUM WINCH

- A. Winch assembly shall be designed and installed to lift and hold the auditorium left and right speaker arrays by others.
- B. The winch set shall be dual drum, motorized, with a rated capacity of 2000 pounds per set and a fixed hoisting speed of 18 to 24 feet per minute. All cables shall run continuously from the batten to the drum without clueing. Each winch drive unit assembly shall consist of a motor, brake, gear reducer, limit switch assembly, and drum. All drives shall be direct.
- C. All winch sets shall be "soft start" and "soft stop", accomplished by means of a high-inertia flywheel or fan associated with the motor.
- D. All winch sets shall be mounted on sound and vibration isolation pads to significantly reduce noise transferred to building structure during operation.
- E. Drums.
 1. Drums shall be machined from ASTM A48-83 Class 30 gray iron castings having a minimum tensile strength of 30,000 psi and a Brinell Hardness of at least 187. Drums shall have a tread diameter of at least 10 inches and shall be machine grooved for 1/4" wire rope, with a groove diameter clearance of .015 inch and a minimum groove depth of .125 inch. Drums shall have sufficient cable capacity in one layer for maximum travel plus three (3) dead wraps. One 17/64-inch diameter hole shall be drilled through the root of the groove for the cable end. This hole shall have an axis which, in section, is angled 45 degrees from a radial line drawn from the shaft to the center of the hole.
 2. Drums shall be closely supported by tapered roller bearings. Each bearing shall be designed for a dynamic radial loading of at least 2,000 pounds at 500 rpm.
 3. Adjustable steel rollers shall be provided to prevent cable from jumping out of grooves. These rollers shall be adjusted so that they do not bear on the cable when the cable is correctly seated in the groove. These rollers shall be supported at both ends by precision ball bearings.
- F. Gear Reducers.
 1. Gear reducers shall be combination helical-worm reducer, directly flange-mounted to the motor/brake assembly. The reducer shall have two gear stages; the first stage shall be helical and the second stage shall consist of a worm and worm wheel. The worm shaft shall be milled, hardened, and ground to insure maximum efficiency and long life.
 2. Gear reducers shall be enclosed in high-strength gray cast iron housings with precisely located gear set bearing supports. Each housing shall have sufficient capacity for lubricant, and surface area for adequate heat dissipation.
 3. Gear reducers shall incorporate a high inertia flywheel at the motor stage for "soft start" and "soft stop" capability.
 4. Gear reducers shall be SEW-Eurodrive "Helical-Worm Gear", or approved equal.
 5. Gear reducers shall be selected to safely transmit specified torque and horsepower and shall have a load classification service factor equal to or greater than 1.3.

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G. Primary Brakes.

1. Brakes shall be directly coupled to the drive train.
2. Brakes shall be fail-safe disc brakes, spring set and electrically released. Brakes shall stop and hold 200% of the full load torque.

H. Secondary Brakes.

1. The secondary brakes shall be a fully mechanical over speed brake, directly mounted to the drum drive shaft. These brakes shall function independently of all other systems, and it shall not require any external sensors, controls, or power sources.
2. The over speed brakes shall engage automatically when the preset speed threshold has been exceeded. It shall be possible to preset the brake tension to adjust the stopping distance, so that it brings the load to a controlled stop without shock.
3. The over speed brakes shall stop and hold 200% of the full load torque.

I. Motors.

1. Motors shall be properly sized for the application.
2. Motors shall be polyphase, general purpose with open drip-proof enclosures. Motors shall be equipped with double sealed ball or roller bearings. Motors shall have a minimum load classification service factor of 1.3 for intermittent operation.
3. Each motor shall be provided with a magnetically operated, mechanically and electrically interlocked, reversing motor starter. Starter shall be sized to match the motor horsepower and rated for intermittent duty. Each motor shall include a thermal overload relay, sized to trip at 115% to 120% of "full load amps" as stamped on the motor nameplate.
4. Each motor shall include an electrical junction box and disconnect switch with terminals of sufficient size and properly labeled, for all external connections.

J. Limit Switches.

1. Limit switches shall be of the rotary type, connected by steel drive chain to the shaft. The input shaft and drive chain shall be fully guarded, and the sprockets shall be keyed to the shafts.
2. Each limit switch shall include a gear-driven, ball bearing supported cam shaft and associated precision, snap-action type contact mechanism.
3. Provide four adjustable limit switches for each winch assembly, as follows:
 - a. Upper limit over-travel backup.
 - b. Upper limit of travel.
 - c. Lower limit of travel.
 - d. Lower limit over-travel backup.
4. Normal travel limit switches, when struck, shall not permit operation of the unit, except in the direction away from the limit switch. Over-travel limit switches, when struck, shall de-energize the motor, and shall not permit travel in any direction until specifically reset at the limit switch enclosure.
5. Lower limit of travel (low trim) shall be +3'-0" above stage floor and upper limit of travel (high trim) shall be the maximum attainable.

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- K. Provide all required mounting hardware pair with speaker mounting hardware provided by AV contractor.
 - L. Device provided and installed by the Stage Rigging Contractor.
 - M. All required power disconnects, feeds, wire and conduit provided and installed by the Electrical Contractor. All power and control connections by the Electrical Contractor.
 - N. Install as shown in the Drawings.
- 2.05 HOIST CONTROL SYSTEM
- A. The system described below is based upon general performance criteria common to the products listed below. No other system shall be considered unless specifically approved by Schuler Shook at least ten (10) days prior to the bid date:
 - 1. J.R. Clancy “Vantis Pendant system.”
 - 2. Approved equal.
 - B. The control system shall be designed for the safe and reliable control of for a minimum of two (2) automated rigging hoists or linesets.
 - C. Physical requirements:
 - 1. The system will be a hand held pendant solution with a dedicated control receptacle mounted to the wall. Provide 25’ cable.
 - 2. The control system shall have an emergency stop “E-STOP” circuit that shall place the system into a “safe-state” condition and remove power to all hoists / axes controlled by the system. E-STOP buttons shall be located at the control console and in remote locations as indicated in the drawings. E-STOP buttons shall be configured as follows:
 - a. Buttons shall be red mushroom style, minimum 1.6 inch diameter.
 - b. Buttons shall be internally illuminated when in E-STOP condition.
 - c. Buttons shall employ turn release mechanism.
 - d. All remote or portable buttons shall include switch guard, minimum 2 inch diameter, to prevent nuisance activation of E-STOP buttons. Switch guard is not required at control console.
 - e. Label: Rigging Control Emergency Stop.
 - 3. Dead man operation.
 - a. The control console shall have an integrated “dead man switch” that requires the presence of an operator to physically hold a momentary switch for the duration of any automated rigging movements.
 - b. Release of the “dead man switch” shall immediately stop all movements and cue sequences.
 - c. Systems that allow hoists / axes to operate without an operator actively present shall not be acceptable.
 - d. Touchscreen “Hold-to-Run” operation shall not be accepted for “dead man” operation.
 - 4. The control console shall include one (1) integrated touch screen for display and selection of cue lists and hoists / axes.
 - 5. The control console shall include integrated “Up”, “Down”, and “Go” buttons or macro buttons that may be assigned these functions.

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6. The control system shall run on industrial computer components and shall be embedded in non-volatile memory.
 7. All programming or cueing shall be recordable to backup media.
 8. The control system shall include a UPS power supply for operation of the control console for a period of ten (10) minutes in the event of power loss.
- D. Operational requirements:
1. The control system shall include a graphical user interface (GUI) for ease of use and clear understanding of system operation. The control system shall provide a graphical representation of programmed moves. The system shall allow for the representation of the stage and generic scenic elements. The control system shall provide a visual status of motor operating and fault conditions.
 2. The control system shall have multiple password protected access levels for maintenance (least access), operator, supervisor, and installer (greatest access).
 3. The operator shall be able to create, store, modify and delete preset positions as a combination of simple up/down movements, preset position targets, speed, time, acceleration, and deceleration.
 4. The operator shall be able to group hoists / axes for synchronized operation.
 5. The control system shall allow soft load and trim limits to be set by the operator. Soft load and trim limits shall only be permitted within the maximum limits set by the system manufacturer.
 6. The control system shall have inherent interlocks and rules-based interlocking to prevent system component conflicts.
- E. Provide all necessary control racks and mounting hardware.
- F. Devices provided and installed by the Rigging Contractor.
- G. All required power disconnects, feeds, wire and conduit provided and installed by Division 26. All power and control connections by Division 26.
- H. Exact locations to be determines in the filed on the stage right proscenium wall.

2.06 CABLE REEL

- A. Provide cable reels and all required hardware for automated extension and retraction of electrical power and data cables.
- B. Speaker cable reels.
1. Circuit quantity.
 - a. Dedicated Speaker wiring. Provide thirty-two (32) #12 AWG conductors for each speaker plus a minimum. Coordinate with A/V contractor.
 2. Cable length: maximum 60'-0" cable required, field verify.
 3. Strain relief: provide Kellems style cable grips at end of every cable for connection to junction box by others.
- C. General requirements.
1. Color: Cable reel housing, cable and sheaves shall all be "black."
 2. Size: Verify that cable reel assemblies may be located as shown on the Drawings. Cable reels shall be mounted to structure. All cable reels shall

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be located to facilitate future service. Blocks can be added if it facilitates service.

- D. Manufacturer:
 - 1. Basis of design to be conductix Wampfler “GafferReel” or approved equal.
- E. Devices provided and installed by the Stage Rigging Contractor.
- F. All required power disconnects, feeds, wire and conduit provided and installed by the Electrical Contractor. All power and control connections by the Electrical Contractor.
- G. Quantities, locations and circuits as shown on the Drawings and in the Schedules.

PART 3 EXECUTION

3.01 FABRICATION

- A. This Contractor is responsible for becoming familiar with and verifying all pertinent dimensions and conditions, both in the Drawings and in the field, before proceeding with any work.
- B. Coordinate the design, planning, and scheduling of the work of this Section with the work of all other trades. Notify the Architect of any difficulties in coordinating work with other contractors. Failure to do so shall constitute acceptance of construction as suitable in all ways to receive the work of this Section.
- C. All electrical components shall be fully assembled and internally wired, with terminals of the proper rating and clearly labeled, provided for external feeder and control wiring.
- D. All metal fabricated items shall be given at least one coat of primer and one coat of finish paint. Color: black.
- E. Where specifically called out in the Drawings and Specifications, tracks and fittings shall be painted or anodized black.
- F. All equipment shall be fabricated and installed to facilitate maintenance and future replacement.
- G. Machinery and equipment supplied under this Section shall be designed, constructed, and installed so that sound pressure levels measured at a distance of 5'-0" shall not exceed 50 decibels at any load or any speed.

3.02 INSTALLATION

- A. Contractor shall employ only experienced stage riggers for the installation of work of this Section. A competent supervisor shall be maintained on this Project during the entire installation. A change of supervisor shall not be acceptable unless by written authorization of the Architect.
- B. Coordinate installation with all other trades doing adjoining work.
- C. Examine all existing conditions at the job site prior to beginning installation.
- D. Provide protection for all stage flooring, regardless of whether flooring has been stained or sealed. Flooring shall be protected from both structural damage and cosmetic damage.
- E. Provide and install all supplementary structural support as required for the installation and safe operation of equipment and materials supplied under this Section.

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- F. Do all required cutting, drilling, tapping, and welding necessary for proper installation. Cut no structural members unless specifically shown in the Drawings or indicated in the Contractor's shop drawings, or unless written approval is obtained from the Architect.
 - G. Install all items in conformity with standard trade practices and manufacturers' recommendations. Position all items accurately and true to plumb line and level. Maintain maximum headroom and clearances at all locations.
 - H. Ropes and cables shall enter rigging blocks and drums at a fleet angle not exceeding ± 2 degrees.
 - I. Steel cables shall be cut just above cable clips or swaged fittings. All cable ends shall be sealed with a bead of heavy-duty silicone adhesive.
 - J. All turnbuckles shall be wired shut after adjustment. All and screw-pin shackles shall be wired shut or secured with plastic cable ties after adjustment.
 - K. Install all winches, winch motor starter panels, and winch control panels with the exception of the electrical power and control connections between devices. All winch power feeds, disconnects, conduit and wire shall be provided and installed by the Division 26 Electrical Contractor.
 - L. Advise the Division 26 Electrical Contractor as required on the installation of electrical equipment related to the work of this Section.
- 3.03 PROTECTION AND CLEANING
- A. Provide protection for any theatre rigging equipment, panels and faceplates installed prior to the completion of construction and painting. Remove any debris or paint from equipment that was not adequately protected. Panels and faceplates not appearing "like new" shall be replaced.
 - B. No curtains or rigging accessories shall be installed until construction and painting are complete and the building has been cleaned. Any curtains or accessories delivered to the job site prior to their installation shall be stored in a clean area in dustproof bags.
 - C. Upon the completion of the work of this Section, dispose of all packing materials, debris and remnants which result from the work of this Section.

END OF SECTION

**SECTION 12 48 13
ENTRANCE FLOOR MATS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Extruded aluminum entrance floor grilles.
- B. Recessed mat frames.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.
- C. Shop Drawings: Indicate dimensions and details for recessed frame.
 - 1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.
- D. Samples: Samples for selection.
- E. Maintenance Data: Include cleaning instructions, and stain removal procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Entrance Floor Grilles and Gratings:
 - 1. Basis of Design: Construction Specialties, Inc; G1 Pedigrid: www.c-sgroup.com/#sle.
 - 2. Nystrom, Inc: www.nystrom.com/#sle.
 - 3. Pawling Corporation: www.pawling.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

- A. Entrance Floor Grilles: Recessed extruded aluminum grille assembly with nominal 1 inch wide tread strips running perpendicular to traffic flow, slots between treads, and perimeter frame forming sides of recess; grille hinged for access to recess.
 - 1. Recess Depth: 3/4 inches.
 - 2. Colors: As indicated on drawings.
 - 3. Length in Direction of Traffic Flow: 72 inches.
 - 4. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
 - 5. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.
 - 6. Pan: Anodized aluminum bottom pan with drain, sealed to frame.
- B. Floor Grids
 - 1. Model and Description: Shall be extruded 6105-T5 aluminum alloy tread rails joined mechanically by extruded 6106-T-6 aluminum alloy key lock bars.
- C. Grid Frames
 - 1. LBDP - Level Base Frame with Drain Pan shall be 6063-T5 aluminum alloy with 1/2" exposed surface and depth of 1 13/16". These assemblies receive 1/4" thick heavy gauge TPE support cushions 1" long mounted to each continuous foot at 24" on center. These assemblies shall also include a 2" I.P.S. PVC drain, stainless steel strainer and a 16-gauge aluminum pan provided by manufacturer. Frame color shall be anodized
- D. Tread Insert
 - 1. HD - MonoTuft HD Carpet shall meet CRI standard for good indoor air quality. Fibers shall include a minimum of 100, 12 mil monofilament fibers per square inch. Each carpet fiber and monofilament shall be fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths. Anti-static carpet fibers shall contain antimicrobial additive and be treated with Scotchgard to reduce soiling. Carpet weight shall be 33- oz/yd².

- a. Color: Graphite, or as selected by Architect from manufacturer's full range.
- E. Mounting: Top of non-resilient members level with adjacent floor.
- F. Structural Capacity: Capable of supporting a rolling load of 500 pounds without permanent deformation or noticeable deflection.
- G. Vibration Resistant Fabrication: All members welded, riveted, or bolted; no snap or friction connections.

2.03 MATERIALS

- A. Aluminum - ASTM B221, alloy 6105-T5 for rail extrusions and 6061-T6 for key lock bars.

2.04 FABRICATION

- A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.
- B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

- A. Mats: Verify size of floor recess before fabricating mats.
- B. Vacuum clean floor recess.

3.03 INSTALLATION

- A. Install frames to achieve flush plane with finished floor surface.
- B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

END OF SECTION

PART 1- GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SCOPE

- A. All materials, components, and services necessary to provide a complete system indicated in this Section, as specified herein and shown on related Drawings, including:
 - 1. Verification of dimensions and conditions at the job site.
 - 2. Preparation and submission of complete shop drawings and samples for approval prior to fabrication.
 - 3. Shipment of equipment to the job site and the secured storage of all non-fixed equipment.
 - 4. Installation and completion in accordance with these Specifications, related Drawings, the Production Lighting Equipment Manufacturer's recommendations, established trade criteria, and all applicable code requirements.
 - 5. The inspection, demonstration, and necessary adjustment of the completed installation by the Production Lighting Equipment Manufacturer's engineering personnel.
 - 6. Preparation and submission of complete record drawings and operational and maintenance data and certificates.

1.03 WORK INCLUDED

- A. The following is for reference only and is not intended to define the limits of the work for a complete installation:
 - 1. Emergency lighting interface devices.
 - 2. Control racks and devices.
 - 3. Network data system.
 - 4. Control receptacle panels.
 - 5. House light control panels.
 - 6. Entry stations.
 - 7. Work light control panels.
 - 8. Wiring devices.
 - 9. Production lighting control console and accessories.
- B. The following work shall be completed by the Contractor but not by the Production Lighting Equipment Manufacturer or Production Lighting Equipment Dealer. The following is for reference only and is not intended to define the limits of work for the Contractor:
 - 1. Electrical feeds, conduit, wire, control cable, and connections except as indicated herein.
 - 2. Testing and certification of network cable and terminations.

1.04 RELATED WORK IN OTHER SECTIONS

- A. The following is for reference only and is not intended to define the limits of the work for a complete installation:
 - 1. Division 26 installation requirements.
 - 2. Electrical sources.
 - 3. Sound and communications systems.

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Link-Seal" as manufactured by Pipeline Seal and Insulator, Inc. or comparable product by one of the following:
 - 1. Metraflex Company (The).
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Composite
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide adequate annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and

sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

END OF SECTION

SECTION 23 0518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
 - 2. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 23 0518

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermometers.
 - 2. Thermowells.
 - 3. Gages.
 - 4. Test plugs.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Terrice,H.O. Co., BX9 Series or comparable product by one of the following:
 - a. Palmer Wahl Instrumentation Group.

- b. Weiss Instruments, Inc.
 - c. Winters Instruments - U.S.
2. Standard: ASME B40.200.
 3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
 4. Case Form: Adjustable angle unless otherwise indicated.
 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 7. Window: Glass or plastic. (Glass on ranges over 300 deg F.)
 8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES. (Use Stainless Steel on MTHW)
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Terrice, H.O. Co., 500X Series or comparable product by one of the following:
 - a. Palmer Wahl Instrumentation Group.
 - b. Weiss instruments, Inc.
 - c. Winters Instruments – U.S.
2. Standard: ASME B40.100.
3. Case: Liquid-filled Open-front, pressure relief type(s); Stainless Steel; 4-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated or required.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/2 pipe threads.
- C. Valves: Brass or stainless-steel needle, with NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Peterson Equipment Co., Inc.
 3. Sisco Manufacturing Company, Inc.
 4. Trerice, H. O. Co.
 5. Watts Industries
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg. F.
- D. Core Inserts: One or two self-sealing rubber valves.
 1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.
- E. Test Kit: Furnish four test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
- F. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
- G. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
- H. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- I. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- J. Install test plugs in piping tees.
- K. Install flow indicators in piping systems in accessible positions for easy viewing.
- L. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- M. Install flowmeter elements in accessible positions in piping systems.
- N. Install permanent indicators on walls or brackets in accessible and readable positions.
- O. Install connection fittings in accessible locations for attachment to portable indicators.
- P. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Scale Range for Condenser-Water Piping: 0 to 150 deg F.
- C. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.
- D. Scale Range for Medium Temperature Heating, Hot-Water Piping: 50 to 400 deg F.
- E. Scale Range for Steam and Steam-Condensate Piping: 0 to 250 deg F.
- F. Scale Range for Air Ducts: 0 to 150 deg F.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 200 psi.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 200 psi.
- C. Scale Range for Condenser-Water Piping: 0 to 160 psi.
- D. Scale Range for Steam Piping: 0 to 30 psi

END OF SECTION

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron ball valves.
4. Iron, single-flange butterfly valves.
5. Iron, grooved-end butterfly valves.
6. Bronze swing check valves.
7. Iron swing check valves.
8. Iron, center-guided check valves.
9. Bronze gate valves.
10. Iron gate valves.
11. Bronze globe valves.
12. Iron globe valves.
13. Chainwheels.

B. Related Sections:

1. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 150, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-335-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-585-70 or a comparable product by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Milwaukee Valve Company.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE, MPTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

2.4 HIGH PERFORMANCE IRON BALL VALVES

A. Class 125, Cast Iron Flanged Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide American Valve, Inc., Model 4000 or a comparable product by one of the following:
 - a. Sure Flow Equipment Inc.
2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig
 - c. Body Design: Split body, bi-directional, tight shutoff.
 - d. Body Material: ASTM A 126, cast iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: PTFE infused cast iron or Stainless steel.
 - i. Port: Full.

B. Class 150, Stainless Steel Flanged Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide American Valve, Inc., Model 4000 or a comparable product by one of the following:
 - a. Sure Flow Equipment Inc.
2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig
 - c. Body Design: Split body, bi-directional, tight shutoff.
 - d. Body Material: ASTM A 351, 316 stainless steel.
 - e. Ends: Flanged.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Ductile Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO LD-1000 or a comparable product by one of the following:
 - a. American Valve.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO LD-2000 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Jenkins Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.6 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO GD-4765 or a comparable product by one of the following:
 - a. Tyco Fire Products LP; Grinnell Mechanical Products.

b. Victaulic Company.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 175 psig.
- c. Body Material: Coated, ductile iron.
- d. Stem: Two-piece stainless steel.
- e. Disc: Coated, ductile iron.
- f. Seal: EPDM.

2.7 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, Metal to Metal Seat High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO LCS-6822 or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Flowseal

2. Description:

- a. Standard: MSS SP-68.
- b. CWP Rating: 285 psig at 100 deg F.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
- e. Seat: Inconel with Graphite packing.
- f. Stem: Stainless steel; offset from seat plane.
- g. Disc: 316 Stainless Steel Nitrided.
- h. Service: Bidirectional.

2.8 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-413 or a comparable product by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-413-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-433 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Milwaukee Valve Company.

2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.9 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO F-918-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.

- g. Trim: Bronze.
- h. Gasket: Asbestos free.

2.10 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO F-910-B or a comparable product by one of the following:
 - a. Metraflex, Inc.
 - b. Milwaukee Valve Company.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Globe, spring loaded.
 - f. Ends: Flanged.
 - g. Seat: Bronze.

B. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO F-960-B or a comparable product by one of the following:
 - a. Metraflex, Inc.
 - b. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Globe, spring loaded.
 - f. Ends: Flanged.
 - g. Seat: Bronze.

C. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO F-910-W or a comparable product by one of the following:
 - a. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.

- d. Body Material: ASTM A 126, gray iron.
- e. Style: Globe, spring loaded.
- f. Ends: Flanged.
- g. Seat: EPDM or NBR.

D. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

- 1. Manufacturers: Subject to compliance with requirements, provide NIBCO F-960-W or a comparable product by one of the following:
 - a. Milwaukee Valve Company.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Globe, spring loaded.
 - f. Ends: Flanged.
 - g. Seat: EPDM or NBR.

2.11 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-113 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

B. Class 150, NRS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-133 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.12 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO F-619 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.

2.13 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-211-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.

- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-211-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

C. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO T-235-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.14 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide NIBCO F-718-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.15 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Direct-mounted valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball and butterfly valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.

- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, butterfly, gate, globe, and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except Steam: Globe, ball, or butterfly valves.
 - 4. Throttling Service, Steam: Globe or angle valves.
 - 5. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: center-guided, metal-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger (except building's main isolation valve):

1. Ductile Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
2. Ductile Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, aluminum-bronze disc.
3. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
4. Iron, Center-Guided Check Valves: Class 125, globe, metal seat.
5. Iron Globe Valves: Class 125
6. Iron Ball Valves, Class 125.

C. Building Main Isolation Valve (interior):

1. Class 150, Single-Flange, Metal to Metal Seat High-Performance Butterfly Valves

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Ductile Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
2. Ductile Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, aluminum-bronze disc.
3. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
4. Iron, Center-Guided Check Valves: Class 125, globe, metal seat.
5. Iron Globe Valves: Class 125.
6. Iron Ball Valves: Class 125

END OF SECTION

SECTION 230529 - HANGERS & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
3. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Pipe stands.

4. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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. Cooper B-Line, Inc.
 - b. Thomas & Betts Corporation.
 - c. Unistrut Corporation; Tyco International, Ltd.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

- 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. ERICO International Corporation.
 2. National Pipe Hanger Corporation.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 5. Piping Technology & Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inchesthick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Section.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Provide Type 2 Hangers (Combination Spring and Fiberglass Hangers, Refer to Section 230548) on suspended piping connected to isolated equipment as follows: 1" up to 4" diameter, first 3 points of support; 5" to 8" diameter, first 4 points of support; 10" diameter and over, first 6 points of support. Static deflection of first point shall be twice deflection of isolated equipment. Floor-mounted piping shall be isolated with Type 2 Spring Isolators.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Valve tags.
 - 6. Warning tags.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F .
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Painting."

- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Chilled Water: 1-1/2 inches, round.
 - b. Heating Water: 1-1/2 inches, round.
 - c. Condenser Water: 1-1/2 inches, round.
 - d. Low-Pressure Steam: 1-1/2 inches, round.
 - e. Steam Condensate: 1-1/2 inches, round.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

- A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.

3. Application.
4. Dates of use.
5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Architect on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.6 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 1. Permanent electrical-power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient spaces in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS
- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal

units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
 2. Check liquid level in expansion tank.
 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Pumps."
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 1. Nameplate data.

2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.13 TOLERANCES

A. Set HVAC system's air flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.14 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.15 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.

- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.

2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per incho.c.
 - f. Make and model number.
 - g. Face area in sq. ft..
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in **Btu/h**.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in **inches**, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in **inches**.
 - 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in **cfm**.
 - b. Entering-air temperature in **deg F**.
 - c. Leaving-air temperature in **deg F**.
 - d. Air temperature differential in **deg F**.
 - e. Entering-air static pressure in **inches wg**.
 - f. Leaving-air static pressure in **inches wg**.
 - g. Air static-pressure differential in **inches wg**.
 - h. Low-fire fuel input in **Btu/h**.
 - i. High-fire fuel input in **Btu/h**.
 - j. Manifold pressure in **psig**.
 - k. High-temperature-limit setting in **deg F**.
 - l. Operating set point in **Btu/h**.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in **Btu/h**.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.

- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.

- J. Air-Terminal-Device Reports:

1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.

- f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft..
2. Test Data (Indicated and Actual Values):
- a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
- a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
- a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
- a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.

2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.16 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 5 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 5 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 5 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the mechanical contractor's final payment.
 - D. Prepare test and inspection reports.

3.17 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Condensate drain piping, indoors and outdoors.
 - 2. Chilled-water and brine piping, indoors and outdoors.
 - 3. Condenser-water piping, indoors when used for water-side economizer or for condensate control and outdoors.
 - 4. Heating hot-water piping, indoors and outdoors.
 - 5. Refrigerant suction and hot-gas piping, indoors and outdoors.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Equipment Insulation."
 - 2. Division 23 Section "Duct Insulation."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.4 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.5 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 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. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide the following:
 - a. Armacell LLC; AP Armaflex.

- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Owens Corning; SOFTR All-Service Duct Wrap.

- I. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville; Micro-Lok.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 - d. Knauf Insulation; Earthwool 1000
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.

- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Armaflex 520 Adhesive.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.

- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.

- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.

- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 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; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 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. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.

 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mildry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 permsat 0.0625-inchdry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.4 SEALANTS

- A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.

- b. Proto Corporation; LoSmoke.
- 2. Adhesive: As recommended by jacket material manufacturer.
- 3. Color: Color-code jackets based on system. Color as selected by Architect.
- 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

- 1. Products: Subject to compliance with requirements,:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. RPR Products, Inc.; Insul-Mate.
- 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.

4. Adhesion: 90 ounces force/inch width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
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. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch width.

2.8 SECUREMENTS

A. Bands:

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. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.
 7. Unions.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Sections for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Sections for penetration firestopping.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement or armaflex sheet insulation.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable

insulation cover at the removable basket. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 8. Label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with armaflex insulation sealed vapor tight. insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Tests and Inspections: Schedule tests and inspections with Owner and CxA with at least seven days' advance notice.
- B. The testing agency shall conduct tests and inspections on duct insulation and shall show compliance to IECC 2006.
- C. Remove and replace insulation deficiencies and retest.
- D. Prepare test and inspection reports.
- E. The installing Contractor or vendor shall correct deficiencies in or remove and replace duct insulation that inspection and test reports indicate does not comply with specified requirements.
- F. Additional inspections and tests, at the installing Contractor's or vendor's expense, will be performed to determine compliance of corrected Work with specified requirements.

END OF SECTION

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
- C. All FMS controls for Mechanical equipment shall be on generator power except for AHU-1 and AHU-2.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. MS/TP: Master slave/token passing.
- D. PC: Personal computer.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F .
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F .
 - e. Ducted Air Temperature: Plus or minus 1 deg F .
 - f. Outside Air Temperature: Plus or minus 2 deg F .
 - g. Dew Point Temperature: Plus or minus 3 deg F .

- h. Temperature Differential: Plus or minus 0.25 deg F .
- i. Relative Humidity: Plus or minus 3 percent.
- j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
- k. Airflow (Measuring Stations): Plus or minus 2 percent of full scale.
- l. Airflow (Terminal): Plus or minus 10 percent of full scale.
- m. Air Pressure (Space): Plus or minus 0.01-inch wg .
- n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
- o. Carbon Dioxide: Plus or minus 50 ppm
- p. Electrical: Plus or minus 5 percent of reading.

1.5 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation.
 - 6. Schedule of dampers including size, leakage, and flow characteristics.
 - 7. Schedule of valves including flow characteristics.
 - 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 - 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 - 10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.

- c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Software and Firmware Operational Documentation: Include the following:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Software license required by and installed for DDC workstations and control systems.
- E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Maintenance instructions and lists of spare parts for each type of control device.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 - 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 4. Calibration records and list of set points.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.8 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system and refer to plans for additional requirements.
- C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- D. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces and refer to plans for additional requirements.
- E. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices and refer to plans for additional requirements.
- F. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices and refer to plans for additional requirements.

1.9 WARRANTY

- A. Equipment: The control system components shall be free from defects in material and workmanship under normal use and service. If within one year from the date of completion any control system equipment is found to be defective, it will be replaced, repaired or adjusted at the option of the control system installer free of charge. The control system installer is not responsible for the removal or reinstallation of any components that were originally installed by others, such as valves, dampers, wells, airflow stations, etc...
- B. Installation: The control system shall be free from defects in installation workmanship for a period of one year from acceptance. This includes defective mounting, wiring, piping, adjustment, calibration, programming, startup and commissioning. The control system installer shall correct any defects in workmanship at no cost to the owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturer:
 - 1. Johhson Controls, Inc.

2.2 CONTROL SYSTEM

- A. All new products provided under this section must be compatible with the existing system.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- D. Control system shall include the following:
 - 1. Interface capabilities with Building lighting control system specified in Division 26 Section "Network Lighting Controls."
 - 2. Interface capabilities with Fire alarm system specified in Division 28 Section "Fire Detection and Alarm."

2.3 DDC SYSTEM GENERAL

A. Network

- 1. The control system shall incorporate a primary Tier 1 network. At the Contractor's option, the control system may also incorporate integrated secondary Tier 2 and tertiary Tier 3 networks.
- 2. The control system Network shall utilize an open architecture capable of all of the following:
- 3. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec
 - a. Connecting via BACnet at the Tier 1 level in accordance with as per ANSI/ASHRAE Standard 135-2001.
 - b. Connecting via BACnet MSTP at the Tier 2 and Tier 3 level.
- 4. The FMS network shall support both copper and optical fiber communication media.

B. Power Fail / Auto Restart

- 1. Provide for the automatic orderly and predefined shutdown of parts or all of the control system following total loss of power to parts or all of the control system.
- 2. Provide for the automatic orderly and predefined startup of parts or all of the control system following total loss of power to those parts or all of the control system. Archive and annunciate time and details of restoration.
- 3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.
- 4. Maintain the control system real-time clock operation during periods of power outage for a minimum of 72 hours.

2.4 Network Automation Engines (NAE)

- A. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
- B. Automation network – The NAE shall reside on the Tier 1 automation network and shall support a subnet of system controllers.

- C. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI). All computers connected physically or virtually to the automation network shall have access to the web based UI.
1. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
 2. The web based user shall have the capability to access all system data through one NAE.
 3. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
 4. Systems that require the user to address more than one NAE to access all system information are not acceptable.
 5. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
 6. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
 7. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
 - a. Configuration
 - b. Commissioning
 - c. Data Archiving
 - d. Monitoring
 - e. Commanding
 - f. System Diagnostics
 8. Systems that require workstation software or modified web browsers are not acceptable.
 9. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
- D. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.
- E. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
- F. Hardware Real Time Clock – The NAE shall include an integrated, hardware-Based, real-time clock.
- G. The NAE shall include troubleshooting LED indicators to identify operating conditions.
- H. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
1. USB port
 2. URS-232 serial data communication port
 3. RS-485 port
 4. Ethernet port
- I. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local

and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

- J. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
 - 1. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 - 2. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
- K. Certification – The NAE shall be listed by Underwriters Laboratories (UL).
- L. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1. The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2. The NAE shall be tested and certified as a BACnet Building Controller (B-BC).

2.5 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 - 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 - 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
6. Power Requirements (Two-Position Spring Return): 24 or 120 V ac.
7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
8. Proportional Signal: 0- to 10-V dc or 4 to 20 mA.

2.6 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system globe valves shall have the following characteristics:
 1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back seating capacity repackable under pressure.
 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Sizing: 5-psig maximum pressure drop at design flow rate.
 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 100 percent of total system (pump) head.
- C. Butterfly Valves: ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
 1. Body Style: Lug
 2. Disc Type: Aluminum bronze.
 3. Sizing: 1-psig maximum pressure drop at design flow rate.
- D. Ball pattern valves shall have the following characteristics:
 1. Up to 2 inches: Forged brass body, chrome plated brass ball, nickel plated brass stem, graphite reinforced PTFE seats with EPDM O-ring backing, screwed ends or solder ends with union.
 2. Over 2 inches: Brass body, stainless steel ball, stainless steel stem, graphite reinforced PTFE seats with EPDM O-ring backing, flanged ends.
 3. Rate for service pressure of 125 psig at 250 degrees F.
 4. Sizing: 5-psig maximum pressure drop at design flow rate.
 5. Flow Characteristics: Two way valves shall have equal percentage characteristics.
 6. Close-Off (Differential) Pressure Rating: Valve actuator shall provide minimum close-off pressure rating of 100 percent of total system (pump) head.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.

3.2 INSTALLATION

- A. Install software in control units. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- F. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. The entire control system shall be installed in a workmanlike manner in accordance with the manufacturer's wiring diagrams. The control system installer shall provide all wiring, conduit, outlet boxes, junction boxes, panels and similar devices necessary for a complete installation.
- B. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- C. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Wiring in mechanical/electrical rooms and concealed spaces shall be in conduit.
 - 3. Exposed wiring shall only be allowed in concealed accessible locations. Wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
 8. All wiring shall be installed in accordance with local code requirements.
- E. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- F. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
1. **Operational Test:** After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test each point through its full operating range to verify that safety and operating control set points are as required.
 4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 5. Test each system for compliance with sequence of operation.
 6. Test software and hardware interlocks.
- C. **DDC Verification:**
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check installation of air supply for each instrument.
 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 8. Check temperature instruments and material and length of sensing elements.
 9. Check control valves. Verify that they are in correct direction.
 10. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.

- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
3. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span.
4. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
5. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
6. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate temperature switches to make or break contacts.
7. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
8. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
9. Provide diagnostic and test instruments for calibration and adjustment of system.
10. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 TRAINING

- A. The control system installer shall provide the following training services:

1. One day on-site orientation consisting of a review of the project as-built drawings and O&M manuals, and a walk through of the facility to identify control panels and device locations. Include instruction on procedures for recovery from a system outage such as resetting of breakers or panels. Also include review of periodic maintenance and adjustment requirements.
2. One day on-site or classroom training to cover all sequences of operation.
3. One day on-site or classroom training to cover user functions of the operator interface. Include such topics as logging-on and off, alarm management, schedule management, data and setpoint display, command, override and adjustment, report generation, and trend log set-up and analysis.
4. One day on-site or classroom training to cover management functions of the operator interface. Include such topics as password management, operator activity review, and system archive and database management.

END OF SECTION 23 09 00

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Chilled-water piping.

1.2 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Chilled-Water: 165 psig at 200 deg F.

1.3 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pipe and fittings.
- B. Shop Drawings: In AutoCAD format, detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Welding certificates.
- D. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 300 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Unions: ASME B16.39; Classes 300 as indicated in Part 3 "Piping Applications" Article.
- D. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- E. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.2 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Dielectric Flanges:

1. Factory-fabricated companion-flange assembly, for 300-psig minimum working pressure as required to suit system pressures.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Chilled-water piping, aboveground, shall be:
 1. Schedule 40 steel pipe, Type E or S, Grade B, black steel, plain ends with weld joints. Flanges to be Class 300.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping to permit valve servicing.
- C. Install piping at indicated slopes.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Install piping to allow application of insulation.
- G. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- I. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- J. Install branch connections to mains using tee fittings in main pipe.
- K. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- L. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- M. Install expansion loops, expansion joints, anchors, and pipe alignment guides in accordance with manufacturers recommendations and instructions.
- N. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2 1/2 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 1/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 - 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 - 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 - 10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
 - 11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
 - 12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
 - 13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
 - 14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
 - 15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

- E. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.7 LEAK-DETECTION SYSTEM INSTALLATION

- A. Double-Containment Piping: Install electronic low point leak-detection systems.
- B. Install panel in location indicated.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment to specified values.
 7. Verify lubrication of motors and bearings.
- D. Perform pressure testing on double-containment piping (primary and secondary) to match system requirements specified.

3.9 STARTUP SERVICE

- A. Perform startup service for leak-detection systems.
1. Complete installation and startup checks in accordance with manufacturer's written instructions.

2. Leak-Detection Systems:

- a. Verify that electrical wiring installation complies with manufacturer's submittal.
- b. Energize circuits.
- c. Adjust operating controls.

3.10 CHEMICAL TREATMENT

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water. Refer to Water Treatment specifications for additional requirements.

END OF SECTION

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Glycol cooling-water piping.
 - 4. Makeup-water piping.
 - 5. Condensate-drain piping.
 - 6. Blowdown-drain piping.
 - 7. Air-vent piping.
 - 8. Safety-valve-inlet and -outlet piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.5 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
1. Hot-Water Heating Piping: 150 psig at 200 deg F.
 2. Chilled-Water and Heat Recovery Piping: 150 psig at 200 deg F.
 3. Makeup-Water Piping: 80 psig at 150 deg F.
 4. Condensate-Drain Piping: 150 deg F.
 5. Blowdown-Drain Piping: 200 deg F.
 6. Air-Vent Piping: 200 deg F.
 7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - b. Flow Design Inc.
 - c. Griswold Controls.
 - d. Taco.
 - e. Nu-Tech Hydronics.
 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Plug: Resin.
 5. Seat: PTFE.
 6. End Connections: Threaded or socket.
 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum 125 psig.
 10. Maximum Operating Temperature: 250 deg F.
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - b. Flow Design Inc.
 - c. Griswold Controls.

- d. Taco.
 - 2. Body: Cast-iron or steel body, ball, or globe pattern with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Stem Seals: EPDM O-rings.
 - 5. Disc: Glass and carbon-filled PTFE.
 - 6. Seat: PTFE.
 - 7. End Connections: Flanged or grooved.
 - 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 9. Handle Style: Lever, with memory stop to retain set position.
 - 10. CWP Rating: Minimum 125 psig.
 - 11. Maximum Operating Temperature: 250 deg F.
- E. Diaphragm-Operated Safety Valves:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Body: Bronze or brass.
 - 3. Disc: Glass and carbon-filled PTFE.
 - 4. Seat: Brass.
 - 5. Stem Seals: EPDM O-rings.
 - 6. Diaphragm: EPT.
 - 7. Wetted, Internal Work Parts: Brass and rubber.
 - 8. Inlet Strainer: , removable without system shutdown.
 - 9. Valve Seat and Stem: Noncorrosive.
 - 10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.3 AIR CONTROL DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 1. Amtrol, Inc.
 - 2. Armstrong Pumps, Inc.
 - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 4. Taco.
 - 5. Thermo-Tech.
 - 6. Twin City Hose.
 - 7. ELBI Tanks (Bladder-Type Expansion Tanks)
 - 8. American Wheatley HVAC Products (Bladder-Type Expansion Tanks)
- B. Manual Air Vents:
- 1. Body: Bronze.

2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

D. Air and Dirt Separators:

1. Straight through flow design (non-centrifugal type), coalescing dirt and air separator for 150 psi operating pressure, with a flanged bottom for cartridge removal sized for 99% air removal with an auto air vent and bottom blow down valve piped to a floor drain as manufactured by Spirotherm, Inc., Model VDN-FA. For high velocity, use Spirotherm, Inc. Model VHN-FA.
2. Other approved Manufacturer: 4900-AD series as manufactured by Taco, Inc., AAR-O-Vent as manufactured by Thrush Co. Inc. and WVA series as manufactured by Wessels Company.
3. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig

B. Stainless-Steel, Flexible Connectors:

1. Body: Stainless-steel with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig
5. Maximum Operating Temperature: 250 deg F.

C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.
- D. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- B. Install air and dirt separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

END OF SECTION

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Supporting devices for electrical components.
 - 2. Concrete equipment bases.
 - 3. Cutting and patching for electrical construction.
 - 4. Touchup painting.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

- A. Product Data: For electricity-metering equipment.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
 - C. Coordinate electrical service connections to components furnished by utility companies.
 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
 - D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Openings."

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.
 1. Channel Thickness: Selected to suit structural loading.
 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- H. Toggle Bolts: All-steel springhead type.
- I. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi, 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

2.3 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 WIRING INSTALLATION

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.
- C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.

- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.4 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.

5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.
9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Thermal and Moisture Protection."

3.6 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Concrete."

3.7 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.8 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 1. Raceways.
 2. Building wire and connectors.
 3. Supporting devices for electrical components.
 4. Electrical identification.
 5. Electricity-metering components.
 6. Concrete bases.
 7. Electrical demolition.
 8. Cutting and patching for electrical construction.
 9. Touchup painting.

3.9 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Finishes."
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 19 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field Quality-Control Test Reports: From Contractor.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.'

2.2 CONDUCTORS AND CABLES

- A. Manufacturers:
 - 1. Alcan Aluminum Corporation; Alcan Cable Div.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. Encore Wire Corporation
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
 - 6. Republic
- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

- C. Conductor Material: Copper, except feeders No. 4 AWG and larger may be aluminum complying with NEMA WC 5 or 7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
- D. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC

2.3 CONNECTORS AND SPLICES

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. AMP Incorporated/Tyco International.
 - 3. Hubbell/Anderson.
 - 4. O-Z/Gedney; EGS Electrical Group LLC.
 - 5. 3M Company; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- H. Underground Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway
- I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- J. Fire Alarm Circuits: Type THHN-THWN, in raceway
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according Division 26 Section "Common Work Results For Electrical."
- F. Fire seal around cables penetrating fire-rated elements.
- G. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems"

3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 7 Section "Thermal and Moisture Protection" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
 - 2. Division 26 Section "Common Work Results for Electrical" for supports, anchors, and identification products.
 - 3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. LFNC: Liquidtight flexible nonmetallic conduit.
- F. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.26
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Design Calculations: Calculate requirements for selecting seismic restraints.
 - 2. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

- A. Manufacturer[s]:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 4. Electri-Flex Co.
 - 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 - 6. LTV Steel Tubular Products Company.
 - 7. Manhattan/CDT/Cole-Flex.
 - 8. O-Z Gedney; Unit of General Signal.
 - 9. Wheatland Tube Co.
 - 10. Republic Conduit
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- F. Plastic-Coated IMC and Fittings: NEMA RN 1.

- G. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Set-screw or compression type.
- H. FMC: Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturer[s]:
 - 1. American International.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corp.
 - 4. Cantex Inc.
 - 5. Certainteed Corp.; Pipe & Plastics Group.
 - 6. Condux International.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; Division of Hubbell, Inc.
 - 12. Spiralduct, Inc./AFC Cable Systems, Inc.
 - 13. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- D. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- E. LFNC: UL 1660.

2.4 METAL WIREWAYS

- A. Manufacturers:
 - 1. Hoffman.
 - 2. Square D.
- B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

- E. Wireway Covers: Screw-cover type.
- F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
 - 1. Manufacturer[s]:
 - a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
 - b. Thomas & Betts Corporation.
 - c. Walker Systems, Inc.; Wiremold Company (The).
 - d. Wiremold Company (The); Electrical Sales Division.
- B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturer[s]:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. Emerson/General Signal; Appleton Electric Company.
 - 3. Erickson Electrical Equipment Co.
 - 4. Hoffman.
 - 5. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - 6. O-Z/Gedney; Unit of General Signal.
 - 7. RACO; Division of Hubbell, Inc.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet-PLM Division.
 - 10. Spring City Electrical Manufacturing Co.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Floor Boxes: Cast metal, fully adjustable, rectangular.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors:
 1. Exposed: Rigid steel or IMC.
 2. Concealed: Rigid steel or IMC.
 3. Underground, Single Run: RNC.
 4. Underground, Grouped: RNC.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 6. Boxes and Enclosures: NEMA 250, Type 3R.
- B. Indoors:
 1. Exposed: EMT.
 2. Concealed: EMT.
 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
 4. Damp or Wet Locations: Rigid steel conduit.
 5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
- C. Minimum Raceway Size: 1/2-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.2 INSTALLATION

- A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 26 Section "Common Work Results for Electrical."
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit.
- I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Use insulating bushings to protect conductors.
- K. Tighten set screws of threadless fittings with suitable tools.
- L. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- N. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- Q. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- R. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- S. Set floor boxes level and flush with finished floor surface.
- T. Set floor boxes level. Trim after installation to fit flush with finished floor surface.
- U. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength: 50 lb, minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 2. Exterior Concrete Unit Masonry:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 3. Exterior Ferrous Metal:
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior semigloss alkyd enamel.
 4. Exterior Zinc-Coated Metal (except Raceways):
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior zinc-coated metal primer.
 - 2) Finish Coats: Exterior semigloss alkyd enamel.
 5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior concrete and masonry primer.
 - 2) Finish Coats: Interior semigloss alkyd enamel.
 6. Interior Concrete Unit Masonry:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
 7. Interior Gypsum Board:

- a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior gypsum board primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
- 8. Interior Ferrous Metal:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior ferrous-metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
- 9. Interior Zinc-Coated Metal (except Raceways):
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior zinc-coated metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
 - 1. Fire Alarm System: Red.
 - 2. Fire-Suppression Supervisory and Control System: Red and yellow.
 - 3. Combined Fire Alarm and Security System: Red and blue.
 - 4. Security System: Blue and yellow.
 - 5. Mechanical and Electrical Supervisory System: Green and blue.
 - 6. Telecommunication System: Green and yellow.
 - 7. Control Wiring: Green and red.
- B. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use aluminum wraparound marker labels write-on tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use write-on tags. Identify each ungrounded conductor according to source and circuit number.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- H. Instruction Signs:
1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.

- b. Access doors and panels for concealed electrical items.
- c. Electrical switchgear and switchboards.
- d. Transformers.
- e. Electrical substations.
- f. Emergency system boxes and enclosures.
- g. Motor-control centers.
- h. Disconnect switches.
- i. Enclosed circuit breakers.
- j. Motor starters.
- k. Push-button stations.
- l. Power transfer equipment.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Battery inverter units.
- p. Battery racks.
- q. Power-generating units.
- r. Voice and data cable terminal equipment.
- s. Master clock and program equipment.
- t. Intercommunication and call system master and staff stations.
- u. Television/audio components, racks, and controls.
- v. Fire-alarm control panel and annunciators.
- w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- x. Monitoring and control equipment.
- y. Uninterruptible power supply equipment.
- z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- aa. First junction box for circuits supplied from generator or UPS.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- E. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.

- c. Phase C: Blue.
- 2. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
- 3. Factory apply color coded insulation the entire length of all phase and grounding conductors according to the voltages as shown in the above table and in accordance with Specification Section 26 0526.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- I. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION

PART 1- GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SCOPE

- A. All materials, components, and services necessary to provide a complete system indicated in this Section, as specified herein and shown on related Drawings, including:
 - 1. Verification of dimensions and conditions at the job site.
 - 2. Preparation and submission of complete shop drawings and samples for approval prior to fabrication.
 - 3. Shipment of equipment to the job site and the secured storage of all non-fixed equipment.
 - 4. Installation and completion in accordance with these Specifications, related Drawings, the Production Lighting Equipment Manufacturer's recommendations, established trade criteria, and all applicable code requirements.
 - 5. The inspection, demonstration, and necessary adjustment of the completed installation by the Production Lighting Equipment Manufacturer's engineering personnel.
 - 6. Preparation and submission of complete record drawings and operational and maintenance data and certificates.

1.03 WORK INCLUDED

- A. The following is for reference only and is not intended to define the limits of the work for a complete installation:
 - 1. Emergency lighting interface devices.
 - 2. Control racks and devices.
 - 3. Network data system.
 - 4. Control receptacle panels.
 - 5. House light control panels.
 - 6. Entry stations.
 - 7. Work light control panels.
 - 8. Wiring devices.
 - 9. Production lighting control console and accessories.
- B. The following work shall be completed by the Contractor but not by the Production Lighting Equipment Manufacturer or Production Lighting Equipment Dealer. The following is for reference only and is not intended to define the limits of work for the Contractor:
 - 1. Electrical feeds, conduit, wire, control cable, and connections except as indicated herein.
 - 2. Testing and certification of network cable and terminations.

1.04 RELATED WORK IN OTHER SECTIONS

- A. The following is for reference only and is not intended to define the limits of the work for a complete installation:
 - 1. Division 26 installation requirements.
 - 2. Electrical sources.
 - 3. Sound and communications systems.

1.05 QUALITY ASSURANCE

- A. The Production Lighting dimming and control system equipment shall be the responsibility of a single Production Lighting Equipment Manufacturer or Production Lighting Equipment Dealer.
- B. The Production Lighting Equipment Manufacturer shall have at least ten (10) years' experience in the fabrication of similar equipment and systems. If requested, the Manufacturer shall submit a representative list of installations during the above period.
- C. Subject to the above requirements, the equipment specified herein shall be provided by one of the following Production Lighting Equipment Manufacturers:
 - 1. Basis of design for control consoles:
 - a. Electronic Theatre Controls (ETC), Middleton, WI.
 - 2. Basis of design for power control and dimmers, Emergency devices:
 - a. Electronic Theatre Controls (ETC), Middleton, WI.
 - b. LynTec, Lenexa, KS.
 - c. Strand Lighting (a division of Philips), Dallas, TX.
 - 3. Basis of design for emergency lighting devices:
 - a. Electronic Theatre Controls (ETC), Middleton, WI.
 - b. Lex Products, Stamford, CT.
 - c. Strand Lighting (a division of Philips), Dallas, TX.
 - 4. Basis of design for lighting Control Data Networking:
 - a. As noted per articles below.
 - 5. Basis of design for wiring devices:
 - a. Altman Stage Lighting, Yonkers, NY.
 - b. Electronic Theatre Controls (ETC), Middleton, WI.
 - c. Lex Products, Stamford, CT.
 - d. Performance Electric, Inc., Greenville, SC.
 - e. Southeast Stage Rigging & Curtains (SSRC), Greenville, SC.
 - f. Stagecraft Industries, Portland, OR.
 - g. Union Connector, Roosevelt, NY.
- D. Other Production Lighting Equipment Manufacturers may be considered with the prior review and approval of Schuler Shook. Manufacturers seeking approval to bid must contact Schuler Shook and provide the following information not less than ten (10) days prior to the bid date:
 - 1. List of projects of similar scale and complexity completed in the last five (5) years. Provide project name, location, completion date, and description of equipment installed.
 - 2. Samples of shop drawing submittals for projects of similar scale and complexity completed in the last five (5) years.
 - 3. Technical data sheets for any product proposed for use on this project.
 - 4. Samples of any products requested by Schuler Shook.
- E. The Production Lighting dimming and control system shall be provided by a qualified Production Lighting Equipment Dealer who shall have at least ten (10) years' experience in the sales and installation of similar systems and who shall be factory certified to provide warranty service for all of the equipment in this Section. Dealer shall meet the requirements for Full Membership in the Entertainment Services and Technology Association (ESTA).

SECTION 26 09 61 – PRODUCTION LIGHTING CONTROL AND EQUIPMENT

- F. The dealer shall be responsible for the integration, operation, and performance of all elements of the system described in this Section. The dealer shall provide all warranty work and equipment upgrades as called for in this Section.
- G. The Dealer shall be available for onsite product service within (24) hours of a call for service.
- H. The following Contractors have submitted the required documentation and have been approved to bid:
- I. The following Systems Contractors have submitted the required documentation and have been approved to bid:
 - 1. Gopher Stage Lighting, Minneapolis, MN; (612) 871-0138.
 - 2. Barbizon Lighting, Denver, CO; (303) 394-9875.
 - 3. Harvest Productions, Kansas City, MO; (816) 483-3889.
 - 4. Vincent Lighting Systems, Erlanger, KY; (859) 525-2000.
 - 5. Beck Studios, Milford, OH; (513) 831-6650.

1.06 SUBMITTALS

- A. Ten (10) days prior to bid.
 - 1. A list of any and all proposed deviations or exceptions from the contract Drawings and Specifications. Any deviations or exceptions from the Drawings or Specifications proposed after this time shall not be accepted. These deviations must be formally approved by Schuler Shook.
- B. With Bid:
 - 1. List of projects of similar scale and complexity completed in the last five (5) years. Provide project name, location, completion date, and description of equipment installed or services provided. Provide contact name, title and phone number for references familiar with Dealer's work on each project listed.
 - 2. Samples of shop drawing submittals for projects of similar scale and complexity completed in the last five (5) years. Sample drawings shall be provided in PDF format only.
 - 3. Name, resume and number of years of employment for Dealer's Project Manager assigned to this project.
 - 4. Dealer shall submit a complete bill of materials to be furnished.
 - 5. A list of any and all formally pre-approved deviations or exceptions from the contract Drawings and Specifications. Any deviations or exceptions from the Drawings or Specifications proposed after bid shall not be accepted.
 - 6. Manufacturer shall indicate any additional wire or conduit runs that are not shown on the Drawings that will be required to install Manufacturer's system.
 - 7. A schedule for the anticipated completion of the following:
 - a. Shop drawings.
 - b. Delivery of all equipment.
 - c. Commissioning of all systems.
- C. Shop Drawings:
 - 1. Within thirty (30) days of receipt of order, the Manufacturer shall submit one (1) complete set of computer-generated drawings in PDF format to the Architect, Electrical Engineer, and Schuler Shook for approval prior to fabrication:
 - a. Dimensions, components, and finishes of all equipment and accessories.
 - b. All system assemblies and major sub-assemblies, cabinets, and enclosures, including notation of type and manufacture of switches, relays, locks, hardware, and electrical and electronic connectors.

- c. Quantities of each component and sub-assembly.
 - d. Block schematics of system internal wiring and system element interconnection.
 - e. Indication by boxed caption of any and all deviations or exceptions from the contract Drawings and Specifications, whether or not those variations have been formally or informally accepted by Schuler Shook.
 - f. Indication by boxed caption of any and all additional wire or conduit runs that are not shown on the Drawings that will be required to install Manufacturer's system.
- D. Samples:
- 1. Within thirty (30) days of receipt of order, the Manufacturer shall, if requested, submit to Schuler Shook for approval prior to fabrication:
 - a. Samples of any equipment component requested by Schuler Shook.
 - 2. Samples shall not be considered part of specified quantities but shall be returned to Manufacturer upon request.
- E. Final Submittal:
- 1. Within thirty (30) days of final tests, and as a condition for final approval, the Contractor shall submit three (3) bound sets to the Owner and one (1) bound set to Schuler Shook:
 - a. Receipts for delivery of all non-installed items, including all items designated, "deliver to Owner." Delivery receipts shall include name and quantity of each piece of equipment specified, with confirmation signature by Electrical Contractor or Owner's representative.
 - b. "As built and approved" CAD drawings and wiring diagrams showing all systems and components as installed, including all field modifications.
 - c. Operation and service manuals, schematics, and parts lists for each unit of equipment installed or provided. A printed, bound manual is required for each control console.
 - d. DVD copies of video-recorded instructions as described below.
 - e. Certificates of warranty, as set forth below.

1.07 TESTING AND INSTRUCTION

- A. Upon completion of all installation work, the Contractor shall certify in writing to the Architect that the work is complete and ready for final inspection. Final inspection shall be scheduled by the Owner, Architect, and Schuler Shook within fourteen (14) days following Contractor's notice of completion.
- B. After system commissioning and adjustment, a knowledgeable representative of the Manufacturer shall operate the system for the approval of the Owner and Schuler Shook.
- C. Necessary adjustments or modifications shall be made as required.
- D. Manufacturer's representative shall instruct the Owner's designated staff or representatives in the operation and maintenance of all equipment as follows:
 - 1. The first instruction session shall encompass a complete and detailed orientation to the system, including all controllers, control accessories, dimmers, receptacle panels, and production lighting fixtures. This instruction session shall be scheduled to last a minimum of eight (8) hours where a minimum of four (4) hours is dedicated to the lighting control console(s).
 - 2. The second instruction session shall include a review of first session topics as requested by the Owner's staff, as well as advanced control console programming. The second session shall occur within sixty (60) days of the first session, or during the first public performance at the Owner's request. This instruction session shall be scheduled to last a minimum of four (4) hours.

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- E. The Manufacturer shall provide to the Owner video-recorded instructions on the operation and maintenance of the system. Information contained in the video will cover all points of operation and maintenance covered in the first instruction session with the Owner's staff. A recording of the actual instruction session is acceptable. Provide two (2) DVDs each containing full copies of the video instruction.

1.08 WARRANTY

- A. For a period of two (2) years following final acceptance, the Production Lighting Equipment Manufacturer shall unconditionally warrant all dimmer modules and dimmer rack control modules provided under this Section to be free from defects in materials and workmanship.
- B. For a period of one (1) year following final acceptance, the Production Lighting Equipment Manufacturer shall unconditionally warrant all other equipment and systems provided under this Section to be free from defects in materials and workmanship. Lamps and normal wear and tear are exempted.
- C. For a period of two (2) years following final acceptance, the Production Lighting Equipment Dealer shall provide and install, at no cost to the Owner, software upgrades to all components of all control systems including consoles and architectural lighting controllers. Thereafter the Dealer shall notify the Owner of all software upgrades for the life of the control system(s). The Dealer shall keep the Owner's name and address in a database for this purpose. All upgrades shall include a full written description of operational modifications. Software upgrades shall be designed so as to allow all existing data, configurations and show files to be maintained, accessed and edited in the future.
- D. Appropriate additional equipment to replace equipment removed for service shall be provided at the job site at no expense to the Owner. Replacement control console(s) must be of the same model as those removed for service.
- E. Warranty service shall be performed by personnel in the employ of the Production Lighting Equipment Manufacturer and shall not be sub-contracted or assigned to another company, service, or individual unless the Owner has approved such assignment in writing, in which event the Production Lighting Equipment Manufacturer shall nevertheless be responsible to the Owner for such work.

1.09 GENERAL REQUIREMENTS

- A. General Conditions of the project contract, work schedules, and site regulations apply to this work.
- B. This work shall comply with all applicable national and local labor regulations.
- C. All parts shall be new, of first quality, and under warranty.
- D. All work and products shall conform to all applicable national and local code requirements. It is the Contractors' responsibility to verify and comply with all national and local codes.
- E. All electrical work and products shall conform to all applicable NFPA 70 National Electric Code (NEC) standards.
- F. All components shall be UL listed and carry pertinent UL labels.
- G. All components shall bear labels identifying the manufacturer, model number, and serial number. All such labels and certificates shall be permanently attached in a conspicuous location.
- H. Identification:
 - 1. All control and receptacle faceplates shall be identified and legended with permanent markings.
 - 2. All control and receptacle faceplates not described elsewhere in this Specification shall be black anodized aluminum or black painted steel, and all labels and legends shall be permanently engraved directly into the faceplate. Minimum text height if not specified elsewhere: 1/4 inch. Engravings shall be filled with white paint. Lamacoid labels shall be acceptable if mechanically fastened to the panel.

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3. Dry transfers, decals, plastic “dymo”, or other types of adhesive labels shall not be used. Silk-screened labels or legends shall not be used.
4. All control and receptacle faceplates shall have beveled edges and rounded corners.
- I. Control signal protocol and connectors shall comply with applicable standards established and published by the U.S. Institute for Theatre Technology. The control signal protocol shall be equal to ANSI E1.11-2004 DMX512-A.
- J. All multi-conductor connectors shall be wired in accordance with the recommended practice RP-1 as published by the U.S. Institute for Theatre Technology.
- K. All control, signal, and video connectors shall be of substantial construction and shall be of the locking or latching type. All plate-mounted connectors shall be bolted to faceplates, rivets shall not be acceptable.
- L. All components requiring external electrical connections of more than seven (7) conductors shall include barrier-type terminal strips properly sized and permanently labeled.
- M. Where specification allows for “approved equal,” substitutions shall be proposed to Schuler Shook no less than ten (10) days prior to bid date.
- N. All equipment shall be fully insured against loss or damage during shipment, job site storage, installation, and testing. The Contractor shall have and assume full responsibility for the safety of every unit of equipment, components, wiring, and plans during delivery, installation, and testing. Certification of such coverage shall be furnished to the Architect within thirty (30) days of award of contract.
- O. For a period of three (3) years following acceptance, the Manufacturer shall provide and install, at no cost to the Owner, all control console operating system upgrades. Thereafter the Manufacturer shall notify the Owner of all operating system upgrades for the life of the console. All upgrades shall include a full written description of operational modifications. Operating system upgrades shall be designed so as to allow existing data to be accessed and upgraded.
- P. For a period of five (5) years following acceptance, the Manufacturer shall maintain service capability by guaranteeing a factory-authorized representative available for on-site service calls within twenty-four (24) hours of notification by Owner of a need for service.
- Q. All control signal terminations shall be made by the Production Lighting Equipment Manufacturers’ installation technician.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Equipment and hardware are specified on the basis of performance and minimum acceptable quality. Materials manufactured by any of the following companies that equals or surpasses the performance and quality specified will be acceptable:
 1. Electronic Theatre Controls (ETC), Middleton, WI.
 2. Other manufacturers as listed for specific components below.

2.02 EMERGENCY LIGHTING INTERFACE DEVICES

- A. Emergency Bypass Detection.
 1. The system described below is based upon general performance criteria common to the products listed below:
 - a. Electronic Theatre Controls “Emergency Bypass Detection Kit EBDK.”
 - b. Approved equal.
 2. Provide Emergency Bypass Detection Kit to sense loss of normal power for each emergency dimmer rack, DMX-controlled relay panel or other device that activates emergency lighting.

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3. Electrical Contractor shall provide 10A 3-pole circuit breaker fed from normal power source for each Emergency Bypass Detection Kit. Loss of any phase shall activate emergency operation. Refer to riser diagram on the drawings.
 4. Provide quantity of Emergency Bypass Detection Kits and 3-pole circuit breakers as required to serve multiple panels or multiple dimmer rooms. Provide all components required for a complete and operable system.
- B. Emergency Bypass Controller.
1. The system described below is based upon general performance criteria common to the products listed below. :
 - a. Electronic Theatre Controls “Emergency Bypass Controller DEBC-6.”
 - b. Approved equal with six (6) DMX outputs.
 2. Provide Emergency Bypass Controller to force DMX data to emergency lighting fixtures into a bypass state. DMX bypass state may bring each DMX control channel to a designated level.
 3. Emergency Bypass Controller shall send a single universe of 512 DMX channels to six (6) optically isolated lines.
 4. Electrical Contractor shall provide emergency power to the Emergency Bypass Controller as well as to all emergency lighting fixtures.
 5. Electrical Contractor shall connect each Emergency Bypass Controller to an Emergency Bypass Detection Kit or equal device to activate emergency operation.
 6. Provide quantity of Emergency Bypass Controllers as required to serve multiple fixture locations or multiple universes of DMX. Provide all components required for a complete and operable system.
 7. Manufacturer’s commissioning technician shall configure each Emergency Bypass Controller to activate all designated emergency lighting fixtures and confirm emergency operation with the Electrical Contractor.

2.03 CONTROL INTERFACE RACKS

- A. Existing racks to remain. New equipment will replace existing equipment in rack.
- B. Maintain existing dry-line infrastructure.
- C. Maintain existing lines to ethernet ports throughout facility. Attach to new patch bays.
- D. Equipment rack in Chapman booth shall contain the following components:
 1. Architectural lighting processor.
 2. Console Processor.
 3. Network switch(s) and patch bay(s).
 4. Centralized DMX Distribution device(s)
 5. Power conditioner with lights (provide one (1) new for each rack).
 6. Rack mounted mounted monitor.
 7. Rack Mounted Keyboard and Trackpad.
 8. 2U Drawer.
 9. CMD_Key EOS keyboard.
 10. Cable management.
 11. Minimum 2U blank rack space for future use.
 12. Blank panels as required.
 13. Additional devices, as required, for a complete and operable system.
- E. Equipment rack stage left on the Chapman stage shall contain the following components:
 1. Remote Video Interface.

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2. Existing Dryline Panel.
 3. CRP-12
 4. Network switch(s) and patch bay(s).
 5. Centralized DMX Distribution device(s)
 6. Power conditioner with lights (provide one (1) new for each rack).
 7. Rack mounted monitor.
 8. Rack Mounted Keyboard and Trackpad.
 9. CMD_Key EOS keyboard.
 10. Cable management.
 11. Minimum 2U blank rack space for future use.
 12. Blank panels as required.
 13. Additional devices, as required, for a complete and operable system.
- F. Equipment rack in the Williams booth shall contain the following components:
1. Architectural lighting processor.
 2. Console Processor.
 3. Network switch(s) and patch bay(s).
 4. Centralized DMX Distribution device(s)
 5. Power conditioner with lights (provide one (1) new for each rack).
 6. Rack mounted monitor.
 7. Rack Mounted Keyboard and Trackpad.
 8. 2U Drawer.
 9. CMD_Key EOS keyboard.
 10. Cable management.
 11. Minimum 2U blank rack space for future use.
 12. Blank panels as required.
 13. Additional devices, as required, for a complete and operable system.
- G. Equipment rack in the Doenges booth shall contain the following components:
1. Architectural lighting processor.
 2. Console Processor.
 3. Network switch(s) and patch bay(s).
 4. Centralized DMX Distribution device(s)
 5. Power conditioner with lights (provide one (1) new for each rack).
 6. Rack mounted monitor.
 7. Rack Mounted Keyboard and Trackpad.
 8. 2U Drawer.
 9. CMD_Key EOS keyboard.
 10. Cable management.
 11. Minimum 2U blank rack space for future use.
 12. Blank panels as required.
 13. Additional devices, as required, for a complete and operable system.
- H. Equipment rack in the Norman booth shall contain the following components:
1. Console Processor.
 2. Network switch(s) and patch bay(s).
 3. Centralized DMX Distribution device(s)

4. Power conditioner with lights (provide one (1) new for each rack).
 5. Rack mounted monitor.
 6. Rack Mounted Keyboard and Trackpad.
 7. 2U Drawer.
 8. CMD_Key EOS keyboard.
 9. Cable management.
 10. Minimum 2U blank rack space for future use.
 11. Blank panels as required.
 12. Additional devices, as required, for a complete and operable system.
- I. All devices installed at the Control Interface Rack shall operate silently if installed within the stagehouse or control room. Fan noise, transformer hum, or other acoustic interference shall not be acceptable.
 - J. Installation shall include appropriate cable management, terminal blocks and labels.
 - K. All devices, stations, and blank panels contained within rack(s) shall be “black.”
 - L. Manufacturer: Middle Atlantic Products or approved equal.
 - M. Install as indicated on the Drawings.

2.04 POWER CONDITIONER WITH BATTERY BACK-UP

- A. Rack-mounted Power Conditioners with battery back-up shall be provided to protect all lighting control devices from electrical irregularities such as surges, “spikes” and emergency transfer. Battery back-up shall be sized to maintain power to all connected devices for a minimum of three (3) fifteen (15) minutes.
- B. Provide one (1) Power Conditioner with battery back-up for each of the following equipment rack locations:
 1. Control interface rack(s) and for all external network devices requiring a power source.
- C. All devices installed at the Stage Manager’s Rack shall operate silently. Fan noise, transformer hum, or other acoustic interference shall not be acceptable.
- D. The device described above is based upon general performance criteria common to the products listed below:
 1. Furman Sound “F1500-UPS.”
 2. American Power Conversion (APC).
 3. Best Power Technology, Inc.
 4. Approved equal.
- E. Install as indicated on the Drawings.

2.05 NETWORK DATA SYSTEM

- A. The Network Data System shall provide for the interconnection of devices used solely for production lighting and special effects.
- B. A dedicated network is required for the lighting control system. The network shall consist of receptacle panels, connecting wiring, patch bays, patch cables, routers, switches, and portable node devices.
- C. All materials, components, and services necessary to provide a complete network data system indicated in this Section. Manufacturer shall be responsible for performance of the complete system.
- D. All lighting control devices shall operate as part of the network. If the manufacturer's system requires devices that are not network compatible, manufacturer shall provide all required hardware to accommodate those devices to meet the intent of this specification.

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Division 26 shall provide and install conduits, boxes, and conductors to accommodate these devices, as part of the work of this Section.

- E. The network shall provide for the connection of the following devices:
 - 1. Control consoles.
 - a. DMX outputs.
 - b. Dimmer feedback information.
 - 2. Remote video displays.
 - 3. Designer's remote control consoles.
 - 4. Hand-held remote controls.
 - 5. Automated lighting fixtures.
 - 6. LED lighting fixtures.
 - 7. DMX-controlled special effects.
 - 8. Architectural lighting control system.
- F. Network capacity shall be determined by the following simultaneous usage criteria. System shall allow all the data below to be sent simultaneously, within the traffic and collision maximums noted below:
 - 1. Control consoles – quantity two (5).
 - 2. Remote video displays – quantity five (5) in use.
 - 3. Hand-held remote controls – quantity two (2).
 - 4. Distributed DMX signal – twenty (20) 512-dimmer universes for automated lighting, color changers and special effects. System shall be designed for the quantity of DMX nodes specified herein and a 50% future expansion of DMX node devices.
 - 5. Architectural lighting control system – as specified herein.
- G. The system shall utilize unshielded twisted pair (UTP) wiring. UTP wiring shall be 4 pair, 24 AWG, unshielded twisted pair wiring. Fiber optic wiring is permissible for "backbone" wiring runs. Fiber optic wiring shall be 62.5/125/900 Micron Fiber Optic wiring. All Category 5e connectors shall be RJ45. All fiber optic connectors shall be ST style connectors.
- H. All elements of the system shall meet the following requirements:
 - 1. Institute of Electrical & Electronic Engineers Standard 802.3: 1996 (E), ANSI/IEEE Standard 802.3, 1993 Edition.
 - 2. Electronic Industries Association/Telecommunications Industries Association Standard 568-1995.
 - 3. TIA/EIA Bulletin TSB67 for field testing of unshielded twisted-pair cabling systems.
 - 4. ESTA CP/96-1057r1 Recommended Practice for Ethernet Cabling Systems in Entertainment Lighting Applications and CP/98-1005r3, Supplement to the Recommended Practice.
- I. All system elements shall be provided from a qualified network hardware manufacturer. The manufacturer shall have at least five (5) years experience in the fabrication of network hardware. The system described below is based upon general performance criteria common to the manufacturers listed below:
 - 1. Allied Telesyn.
 - 2. Bay Networks.
 - 3. Cisco Systems.
 - 4. 3Com Corporation.
 - 5. Hubbell Premise.
 - 6. Panduit.
- J. Network Switches:

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1. The System shall utilize Network Switches for data distribution. The Switches shall be rack-mounted in the Control Interface Rack(s) and completely wired internally.
 2. The Switches shall include sufficient ports for patching all network devices, plus six (6) spare receptacles per Control Interface Rack.
 3. The Switches shall accommodate 100Mbps transmission rate.
 4. All Switch ports shall be labeled with designation of wire destination.
- K. Network Patch Panels:
1. The System shall utilize central Patch Panels for patching individual network devices to the Switches. The Panels shall be rack-mounted in the Control Interface Rack(s) and completely wired internally.
 2. The Panels shall include sufficient network receptacles for patching all network devices, plus six (6) spare receptacles per Control Interface Rack.
 3. The Panels shall allow for distribution of the network wiring. If multiple collision domains exist in the same patch panel, they must use patch cables of different colors to delineate the separate collision domains.
 4. The Rack shall include wire management panels as manufactured by Panduit or approved equal.
 5. All wires shall be identified at the jacket with separate numbers.
 6. All network receptacles shall be labeled with designation of wire destination.
- L. Network Cables and Patch Cables:
1. Cables shall be rated Category 5e to match installed wiring.
 2. Cables shall include RJ45 plugs at each end, for proper mating to receptacle panels and node devices. Each cable shall be protected by a rubber boot of a diameter sufficient to extend beyond the plug connection tab.
 3. Patch cables and boots shall use multiple colors to differentiate collision domains. Drop cables and boots 10'-0" long or more shall be black.
 4. Provide one (1) patch cable of appropriate length for patching each switch port to the designated network receptacle. Provide one (1) spare patch cable for each spare switch port.
 5. Deliver to Owner.
- M. Wiring Methods:
1. All permanent network wiring shall terminate in receptacles in panels. All equipment shall be connected to receptacles via "patch cables" with RJ45 plugs. No installed wire shall terminate directly to network equipment. The use of male RJ45 pigtails shall not be permitted.
 2. Cable shall be pulled in conduits, meeting the minimum bending radius permitted by the cable manufacturer. All cable shall be pulled with no more than the maximum pulling tension permitted by the cable manufacturer.
 3. Riser rated or plenum rated cable shall be used where required under local codes.
- N. Electrical Requirements:
1. All UTP wiring segments shall be of continuous runs of not more than 250 feet. If a wiring run exceeds the noted maximum footage, manufacturer shall provide required repeaters and system elements to bring the wiring segment to the stated maximum run. Contractor shall provide and install such elements as part of the work of this Section.
 2. All cable shall meet the standards for EIA/TIA 568 TSB-36 Category 5e. The Contractor shall use a current generation 100Mhz or higher, network/cable analyzer to perform testing on the cable plan and shall test all data pairs. All cable shall be tested for continuity, attenuation, near end crosstalk, mutual capacitance, cable

impedance, cable resistance, cable length, structural return loss and pair mapping. All testing will be performed by certified cable technicians. As part of the final submittal, provide cable analyzer printouts of all test performed, labeled by cable number.

3. All wiring shall meet the EIA/TIA T586B wiring standard.
4. All cable and installation shall accommodate 100Mbps transmission rate. "Thin Net" systems shall not be used.
5. The system shall be designed for maximum 40% traffic utilization and maximum 10% collisions within the same collision domain. The use of switches is acceptable to manage network traffic.
6. All Layer 2 switches shall provide for IGMP Layer 3 snooping to accommodate IP multicast events.

2.06 NETWORK NODES

A. Rack Mounted Node Devices:

1. The device described below is based upon general performance criteria common to the products listed below:
 - a. Electronic Theatre Controls "Response MK2 four Port Gateway."
 - b. Pathway Connectivity "Pathport Quattro Node."
 - c. Pathway Connectivity "Pathport Octo Node."
2. Node device(s) shall be rack mounted, for the connection of equipment control racks.
3. Node(s) shall have receptacles for connection of network cables.
4. Node(s) shall have a minimum of four (4) DMX output receptacles.
5. Provide four (4) male-to-male DMX turn-arounds for each node.
6. Quantities per schedule.

B. Portable DMX Node Devices – Two Port:

1. The device described below is based upon general performance criteria common to the products listed below:
 - a. Electronic Theatre Controls "Response MK2 Two Port Gateway."
 - b. Pathway Connectivity "Pathport C-Series."
2. Node device(s) shall be portable, for the connection of equipment at control receptacle panels.
3. Node(s) shall have receptacles for connection of network cables.
4. Node(s) shall have two (2) DMX output receptacles.
5. Provide two (2) male-to-male DMX turn-arounds for each node.
6. Node shall operate with power over Ethernet. Provide appropriate power injectors as required.
7. Provide C-Clamp or Scaffold Clamp mounting integral to portable node device.
8. Provide one (1) 25'-0" network cable for each portable node.
9. Quantities per schedule. Deliver to Owner.

C. Install as indicated on the Drawings.

2.07 DISTRIBUTED DMX DRIVER

- A. The Control Interface Rack shall include an optically isolated distribution device capable of providing discrete DMX512 signals. The device(s) shall be rack-mounted and provide discrete DMX control lines to the indicated Control Receptacle Panels and to the dimmer racks.
- B. All wires shall be identified at the jacket with separate numbers.

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- C. The device(s) shall use a dedicated multiplexed signal conforming to the ANSI E1.11-2004 DMX512-A standard.
- D. The device(s) shall provide one discrete output for each DMX output receptacle in the system plus four (4) spare outputs. Provide terminals for the connection of all DMX wiring.
- E. Manufacturer: Pathway Connectivity or approved equal.
- F. Install as required to integrate new equipment in to the existing system.

2.08 CONTROL RECEPTACLE PANEL

- A. The Control Receptacle Panels shall be deadfront, and completely wired internally, with terminal strips of the proper rating for all external connections. Appropriate back boxes shall be provided for all panels.
- B. The face of each panel shall contain flush mounted receptacles for connection to the devices indicated. These receptacles shall be of the locking type and shall be sized for the proper number and capacity of conductors.
 - 1. Ethernet connectors shall be RJ45.
 - 2. Smaller or less substantial connectors shall not be acceptable.
- C. All CRP faceplates shall have a factory-applied paint or anodized finish as indicated in the finish schedule on the Drawings.
- D. All faceplates shall be engraved at each connector and backfilled with contrasting epoxy paint. Connector labels as indicated on the Drawings.
- E. All CRP panels shall be mounted as indicated on the Drawings and in the Schedules. Provide appropriate back boxes for all CRP panels. Verify all mounting conditions.
- F. Install as indicated on the Drawings.

2.09 ARCHITECTURAL LIGHTING CONTROL PROCESSORS

- A. The system described below is based upon general performance criteria common to the products listed below:
 - 1. Electronic Theatre Controls “Unison Paradigm Architectural Control Processor.”
 - 2. Approved equal.
- B. Lighting control racks shall be interconnected as noted on the riser diagrams to allow centralized control of remote fixtures or relays. Provide network or fiber optic cabling as required due to distance between racks.

2.10 HOUSE LIGHT PANEL - LCD

- A. The system described below is based upon general performance criteria common to the products listed below:
 - 1. Electronic Theatre Controls “Unison Paradigm Touchscreen.”
- B. Physical Requirements:
 - 1. The Lighting Control Panel shall be deadfront and completely wired internally, with terminals of the proper rating for all external wiring.
 - 2. The face of the panel shall have a touch-screen capable of selection, programming and control of the lighting presets.
 - 3. All control wiring shall be low-voltage Class II.
- C. Operational Requirements:
 - 1. Each panel shall have the capability to access a minimum of ninety nine (99) presets, plus OFF.
 - 2. Each panel shall have the capability to access a minimum of (1024) dimmers.
 - 3. The presets shall be programmed by adjusting and recording the levels of the house light control channels. Presets shall be capable of user-defined sequences.

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4. All presets shall have an adjustable fade rate control.
 5. The system shall include Macro capability of channels, presets, playback and custom conditional statements.
 6. The record function shall be capable of being locked by a passcode to prevent unauthorized use.
 7. The system set-up shall be protected by a separate passcode.
 8. The system shall provide printable reporting information on the status of all presets, macros, processors, and stations.
 9. The system shall accept graphical inputs to allow custom LCD screen configuration.
- D. The system shall provide for storing of all program, preset and system set-up configuration to removable media.
- E. All House Light Panels shall be mounted as indicated on the Drawings and in the Schedules. Provide appropriate back boxes for all panels. Verify all mounting conditions.
- F. Portable HLP shall include a 25'-0" cable with connector suitable for mating with the control receptacle panels.
1. Portable HLP shall consist of a standard LCD panel, per specification, mounted in a custom enclosure, per the drawings.
 2. Portable HLP shall utilize network ports to connect to the lighting control network and shall operate on PoE and external power supply.
- G. Faceplate color and labels shall be as indicated in the Schedules. Manufacturer shall confirm all faceplate colors and labels in shop drawings.
- H. All faceplates shall be labeled: "House Lights."
- I. Install as indicated on the Drawings and in the Schedules. House Light Panels are identified as "HLP" throughout the documents.

2.11 ENTRY STATION

- A. The system described below is based upon general performance criteria common to the products listed below:
1. Electronic Theatre Controls "Unison Heritage Series Button Station."
- B. Physical Requirements:
1. The panels shall be deadfront and completely wired internally, with terminals of the proper rating for all external wiring.
 2. The face of each panel shall contain momentary contact switches for accessing lighting presets and non-dims as indicated. All buttons shall have integral LED's, illuminated when activated.
 3. All faceplates shall contain an LED indicator lamp for ease of identifying in a darkened room.
 4. All control wiring shall be low-voltage Class II.
- C. Operational Requirements:
1. Each panel shall contain momentary contact switches for accessing lighting presets as indicated in the Schedules.
- D. All Entry Station panels shall be mounted as indicated in the schedule. Provide appropriate back boxes for all panels. Verify all mounting conditions.
- E. Faceplate color and labels shall be as indicated in the Schedules. Manufacturer shall confirm all faceplate colors and labels in shop drawings.
- F. Provide a clear, lockable cover plate and two (2) keys for each station as indicated in the schedule. Locking cover assembly shall be painted to match station faceplate. Deliver keys to Owner.
1. Coordinate exact mounting location with project Electrical Engineer.

- G. Install as indicated on the Drawings and in the Schedules. Entry Stations are identified as “ES” throughout the documents.

2.12 PRODUCTION LIGHTING CABLES

- A. Permanently-installed Ethernet or DMX Cable:
- All cables shall contain 4-pair, #23 AWG, shielded Category 5e wiring. Refer to the following standards for DMX signals on 4-pair cable:
 - ANSI E1.11-2008 Revised 2013 “USITT DMX512-A, Asynchronous Serial Digital Data Transmission Standard....”
 - ANSI E1.27-2-2009 Revised 2014 “Recommended Practice for Permanently Installed Control Cables for Use with ANSI E1.11.”
 - ESTA “DMX512 Over Category 5 Cable Summary.”
 - All permanently-installed lighting data cable shall be in conduit. All cables shall be terminated at the Control Interface Rack(s) and at the Control Receptacle Panel(s) with no breaks or splices between devices.
 - Cable terminations shall follow the ESTA color code and all Production Lighting Manufacturer recommendations.
 - For cable runs exceeding 1000 feet (300 meters), fiber optic cable is required. Refer to Production Lighting Manufacturer’s standards.
- B. Portable Ethernet Cable:
- Portable Ethernet cable shall be used for all plug strip data cables and portable Ethernet cables that are delivered to the Owner for production use.
 - Cable shall contain 4-pair, #23 AWG, shielded Category 5e wiring. Cable jacket shall be UV resistant polyurethane.
 - All cable jackets shall be black unless specifically noted otherwise.
 - Cables shall be Lex Products “PowerFlex” or TMB “ProPlex” or approved equal.
- C. Portable DMX Cable:
- Portable DMX cable shall be used for all portable DMX cables that are delivered to the Owner for production use.
 - Cable shall contain 2 pair, #22 AWG, shielded twisted pair wiring. Cable jacket shall be UV resistant polyurethane.
 - All cable jackets shall be black unless specifically noted otherwise.
 - Cables shall be Lex Products “PowerFlex” or TMB “ProPlex” or approved equal.
- D. Quantities per wiring device and accessory specifications, Drawings and Schedules.

2.13 PRODUCTION LIGHTING CONNECTORS

- A. Ethernet Connectors:
- Ethernet connectors shall be RJ45, Neutrik “etherCON” with integral strain relief. All connectors shall be black.
 - Cable connectors shall be Neutrik NE8MC-B.
 - Panel mount receptacles shall be Neutrik NE8FDV-B.
 - Ethernet extension cables for fixtures or consoles that do NOT utilize “etherCON” panel mount receptacles shall be heavy-duty RJ45, Lex Products or approved equal.
- B. DMX Connectors:
- DMX connectors shall be 5-pin XLR with integral strain relief. All connectors shall be black.
 - Male connectors shall be Neutrik NC5MXX-B.
 - Female connectors shall be Neutrik NC5FXX-B.

4. Male panel mount receptacles shall be Neutrik NC5MD-L-B-1.
 5. Female panel mount receptacles shall be Neutrik NC5FD-L-B-1.
- C. Quantities per lighting fixture specifications, accessory specifications, drawings and schedules.

2.14 CONTROL CONSOLE

- A. The system described below is based upon general performance criteria common to the products listed below. No other system shall be considered unless specifically approved by Schuler Shook at least ten (10) days prior to the bid date:
1. Electronic Theatre Controls “Apex 10 – 24K.”
- B. Physical Requirements:
1. The console shall be deadfront, modular in construction, with plug-in control components, completely wired internally, and shall contain, but not be limited to, the following components:
 - a. Console shall allow include two (2) 23.8-inch LCD touch screens for display and direct selection of console functions.
 - b. One (1) additional 9-inch LCD touch screen with six (6) encoder wheels for automated lighting control.
 - c. Keypad for patching, level setting, and cue recording.
 - d. Playback controls, including split crossfader.
 - e. Minimum ten (10) 60mm motorized faders, 100 10-fader pages for configurable faders, for channel, submaster and palette/preset, timing and effect rate/speed playback control.
 - f. Minimum ten (10) backlit scroll wheel faders with button, 100 10-fader pages for configurable faders, for channel, submaster and palette/preset, timing and effect rate/speed playback control.
 - g. Six force-feedback encoders for non-intensity parameter controlHard drive for recording of all patch, submaster, and cue information.
 - h. Minimum eight (8) backlit mini encoders for non-intensity parameter control, plus one mini encoder for navigation
 - i. Minimum one (1) Dedicated 10.1-inch high-resolution encoder display
 - j. USB ports to access external storage media for recording of all patch, submaster, and cue information.
 - k. USB ports to connect to peripherals (keyboard, mouse, (3) three monitors, etc.)
- C. Operational requirements:
1. The console shall control a minimum of 24,576 DMX outputs on a minimum of 32,768 channels.
 2. A minimum of 100,000 cues shall be recorded, along with fade times, by means of a keypad.
 3. Console shall be able to record part cues or have the ability to provide individual fade times for each channel.
 4. A minimum of 100 fader pages
 5. The console shall have a minimum of 10000 groups and 10000 effects.
 6. It shall be possible to record and modify cues “blind.”
 7. Control and programming features for automated fixtures shall include:
 - a. A standard library of fixture profiles.
 - b. The ability to copy and edit existing profiles and create new profiles.
 - c. Patch displays including channel and output addressing.

- d. 16-bit fade resolution.
 - e. Color characterization allowing color mixing.
 - f. Simple selection of fixtures and attributes.
 - g. The use of encoders for quick adjustments of pan and tilt.
8. In the event of a loss of power, an internal battery backup power supply shall hold all memory information for up to 24 hours.
- D. Install in the Chapman music hall booth.

2.15 CONTROL CONSOLE

- A. The system described below is based upon general performance criteria common to the products listed below. No other system shall be considered unless specifically approved by Schuler Shook at least ten (10) days prior to the bid date:
- 1. Electronic Theatre Controls “Apex 5 – 24K.”
- B. Physical Requirements:
- 1. The console shall be deadfront, modular in construction, with plug-in control components, completely wired internally, and shall contain, but not be limited to, the following components:
 - a. Console shall allow include two (2) 23.8-inch LCD touch screens for display and direct selection of console functions.
 - b. One (1) additional 9-inch LCD touch screen with six (6) encoder wheels for automated lighting control.
 - c. Keypad for patching, level setting, and cue recording.
 - d. Playback controls, including split crossfader.
 - e. Minimum five (5) 60mm motorized faders, 100 10-fader pages for configurable faders, for channel, submaster and palette/preset, timing and effect rate/speed playback control.
 - f. Minimum five (5) backlit scroll wheel faders with button, 100 10-fader pages for configurable faders, for channel, submaster and palette/preset, timing and effect rate/speed playback control.
 - g. Six force-feedback encoders for non-intensity parameter controlHard drive for recording of all patch, submaster, and cue information.
 - h. Minimum eight (8) backlit mini encoders for non-intensity parameter control, plus one mini encoder for navigation
 - i. Minimum one (1) Dedicated 10.1-inch high-resolution encoder display
 - j. Hard drive for recording of all patch, submaster, and cue information.
 - k. USB ports to access external storage media for recording of all patch, submaster, and cue information.
 - l. USB ports to connect to peripherals (keyboard, mouse, (3) three monitors, etc.)
- C. Operational requirements:
- 1. The console shall control a minimum of 24,576 DMX outputs on a minimum of 32,768 channels.
 - 2. A minimum of 100,000 cues shall be recorded, along with fade times, by means of a keypad.
 - 3. Console shall be able to record part cues or have the ability to provide individual fade times for each channel.
 - 4. A minimum of 100 fader pages
 - 5. The console shall have a minimum of 10000 groups and 10000 effects.
 - 6. It shall be possible to record and modify cues “blind.”

7. Control and programming features for automated fixtures shall include:
 - a. A standard library of fixture profiles.
 - b. The ability to copy and edit existing profiles and create new profiles.
 - c. Patch displays including channel and output addressing.
 - d. 16-bit fade resolution.
 - e. Color characterization allowing color mixing.
 - f. Simple selection of fixtures and attributes.
 - g. The use of encoders for quick adjustments of pan and tilt.
 8. In the event of a loss of power, an internal battery backup power supply shall hold all memory information for up to 24 hours.
- D. Install one (1) console stage left in the Chapman music hall and one (1) console in the Williams Theatre booth.

2.16 CONTROL PROCESSOR

- A. The system described below is based upon general performance criteria common to the products listed below. No other system shall be considered unless specifically approved by Schuler Shook at least ten (10) days prior to the bid date:
1. Electronic Theatre Controls “Apex Processor.”
- B. Physical Requirements:
1. The processor shall be deadfront, modular in construction, with plug-in control components, completely wired internally, and shall contain, but not be limited to, the following components:
 - a. Processor shall fit in 2U 19-inch rack-mount form factor.
 - b. Hard drive for recording of all patch, submaster, and cue information.
 - c. USB ports to access external storage media for recording of all patch, submaster, and cue information.
 - d. USB ports to connect to peripherals (keyboard, mouse, (3) three monitors, etc.)
- C. Operational requirements:
1. The console shall control a minimum of 24,576 DMX outputs on a minimum of 32,768 channels.
 2. A minimum of 100,000 cues shall be recorded, along with fade times, by means of a keypad.
 3. Console shall be able to record part cues or have the ability to provide individual fade times for each channel.
 4. A minimum of 100 fader pages
 5. The console shall have a minimum of 10000 groups and 10000 effects.
 6. It shall be possible to record and modify cues “blind.”
 7. Control and programming features for automated fixtures shall include:
 - a. A standard library of fixture profiles.
 - b. The ability to copy and edit existing profiles and create new profiles.
 - c. Patch displays including channel and output addressing.
 - d. 16-bit fade resolution.
 - e. Color characterization allowing color mixing.
 - f. Simple selection of fixtures and attributes.
 - g. The use of encoders for quick adjustments of pan and tilt.
 8. In the event of a loss of power, an internal battery backup power supply shall hold all memory information for up to 24 hours.

- D. Install one (1) processor in the Chapman music hall booth control rack and one (1) processor in the Williams Theatre booth control rack.

2.17 CONTROL CONSOLE

- A. The system described below is based upon general performance criteria common to the products listed below. No other system shall be considered unless specifically approved by Schuler Shook at least ten (10) days prior to the bid date:
 - 1. Electronic Theatre Controls “Ion Xe – 12K” with 1x10 Fader Wing.
- B. Physical Requirements:
 - 1. The console shall be deadfront, modular in construction, with plug-in control components, completely wired internally, and shall contain, but not be limited to, the following components:
 - a. Console shall allow for a minimum of two (2) full-size LCD monitors or touch screens for display and direct selection of console functions.
 - b. Minimum four (4) encoder wheels for automated lighting control.
 - c. Keypad for patching, level setting, and cue recording.
 - d. Playback controls, including split crossfader.
 - e. Hard drive for recording of all patch, submaster, and cue information.
 - f. USB ports to access external storage media for recording of all patch, submaster, and cue information.
 - g. USB ports to connect to peripherals (keyboard, mouse, etc.)
- C. Operational requirements:
 - 1. The console shall control a minimum of 12,000 DMX outputs on a minimum of 16,000 channels.
 - 2. A minimum of 10,000 cues shall be recorded, along with fade times, by means of a keypad.
 - 3. Console shall be able to record part cues or have the ability to provide individual fade times for each channel.
 - 4. A minimum of 999 virtual faders shall be available to accommodate 100 simultaneous fades.
 - 5. The console shall have a minimum of 1000 groups and 1000 effects.
 - 6. It shall be possible to record and modify cues “blind.”
 - 7. Control and programming features for automated fixtures shall include:
 - a. A standard library of fixture profiles.
 - b. The ability to copy and edit existing profiles and create new profiles.
 - c. Patch displays including channel and output addressing.
 - d. 16-bit fade resolution.
 - e. Color characterization allowing color mixing.
 - f. Simple selection of fixtures and attributes.
 - g. The use of encoders or wheels for quick adjustments of pan and tilt.
 - 8. In the event of a loss of power, an internal battery backup power supply shall hold all memory information for up to 24 hours.
- D. Install one (1) console in the control Doenges Booth, one (1) console in the control Norman Booth, and deliver one (1) console to the owner.

2.18 CONTROL PROCESSOR

- A. The system described below is based upon general performance criteria common to the products listed below. No other system shall be considered unless specifically approved by Schuler Shook at least ten (10) days prior to the bid date:
 - 1. Electronic Theatre Controls “Ion Xe RPU
- B. Physical Requirements:
 - 1. The processor shall be deadfront, modular in construction, with plug-in control components, completely wired internally, and shall contain, but not be limited to, the following components:
 - a. Processor shall fit in 2U 19-inch rack-mount form factor.
 - b. Hard drive for recording of all patch, submaster, and cue information.
 - c. USB ports to access external storage media for recording of all patch, submaster, and cue information.
 - d. USB ports to connect to peripherals (keyboard, mouse, (3) three monitors, etc.)
- C. Operational requirements:
 - 1. The console shall control a minimum of 12,000 DMX outputs on a minimum of 16,000 channels.
 - 2. A minimum of 10,000 cues shall be recorded, along with fade times, by means of a keypad.
 - 3. Console shall be able to record part cues or have the ability to provide individual fade times for each channel.
 - 4. A minimum of 999 virtual faders shall be available to accommodate 100 simultaneous fades.
 - 5. The console shall have a minimum of 1000 groups and 1000 effects.
 - 6. It shall be possible to record and modify cues “blind.”
 - 7. Control and programming features for automated fixtures shall include:
 - a. A standard library of fixture profiles.
 - b. The ability to copy and edit existing profiles and create new profiles.
 - c. Patch displays including channel and output addressing.
 - d. 16-bit fade resolution.
 - e. Color characterization allowing color mixing.
 - f. Simple selection of fixtures and attributes.
 - g. The use of encoders or wheels for quick adjustments of pan and tilt.
 - 8. In the event of a loss of power, an internal battery backup power supply shall hold all memory information for up to 24 hours.
- D. Install one (1) processor in the control Doenges Booth and one (1) processor in the control Norman Booth.

2.19 CONTROL ACCESSORIES

- A. Flat Screen Monitors.
 - 1. 23” rack mount monitors
 - 2. Provide 27-inch minimum color LCD monitors for use with main console to display patch, submaster, channel levels, and cue sheet. Monitors for consoles shall provide compatible touchscreen operation.
 - 3. Provide additional 24-inch LCD color monitors for remote video location. Provide additional cables to connect monitors to the console and to the interface for a complete and operable system. Monitors for consoles shall provide compatible touchscreen operation.

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4. Provide monitors as indicated in the Schedule of Quantities.
- B. Dust Covers.
 1. Provide vinyl dust covers for all consoles and all monitors.
- C. Storage Media.
 1. Provide appropriate spare storage media for control console. Removable flash media shall be a minimum of 2GB.
- D. Task Lighting.
 1. Provide 18-inch LED task lighting fixtures with dimmers and weighted bases. Littlite LED or pre-approved equal.
 2. Provide one (1) 18XR-LED for each lighting console, verify console connector type.
 3. Provide additional LW-18-LED with dimmers and weighted bases per Schedule of Quantities.
- E. Keyboard.
 1. Provide standard keyboard for any console that supports an external keyboard. Keyboard color: black.
 2. Provide standard keyboard for any remote video device that supports an external keyboard at the remote video location. Keyboard color: black.
 3. Provide Cmd_Key Keyboard as noted.
- F. Mouse.
 1. Provide standard mouse for any console that supports an external mouse. Mouse color: black.
 2. Provide standard mouse for any remote video device that supports an external mouse at the remote video location. Mouse color: black.
- G. Uninterruptible Power Supply (UPS):
 1. Separate external power conditioner with battery back-up shall be provided to protect lighting control console from electrical irregularities such as surges, “spikes” and emergency transfer. Battery back-up shall be sized to maintain power to all connected devices for a minimum of 15 minutes.
 2. Manufacturer: American Power Conversion (APC) or Best Power Technology, Inc. or approved equal.
- H. Remote Video Interface:
 1. The device described below is based upon general performance criteria common to the products listed below. No other device shall be considered unless specifically approved by Schuler Shook at least ten (10) days prior to the bid date:
 - a. Electronic Theatre Controls “EOS Remote Video Interface.”
 2. Remote video interface(s) shall be portable, for the connection at control receptacle panels via network cable.
 3. Remote video interface(s) shall have two (2) video output receptacles.
 4. Remote video interface(s) shall have receptacles for connections to standard keyboard and mouse.
 5. Provide one (1) 25'-0” network cable for each remote video interface.
 6. Quantities per schedule. Deliver to Owner.
- I. Remote Video and DMX Interface:
 1. The devices described below is based upon general performance criteria common to the products listed below. No other device shall be considered unless specifically approved by Schuler Shook at least ten (10) days prior to the bid date:
 - a. Electronic Theatre Controls “ETCnomad Puck 512” and “Gadget 2.”

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2. Remote video device(s) shall be portable, for the connection at control receptacle panels via network cable.
 3. Remote video device(s) shall include two (2) video output receptacles.
 4. Remote video device(s) shall include receptacles for connections to standard keyboard and mouse. Provide dedicated keyboard and mouse as described above.
 5. Provide one (1) 25'-0" network cable for each remote video device.
 6. Provide one (1) Stage Group Limited "Ixkeyleos" available in the US from High Output, Canton, MA.
 7. DMX interface device(s) shall include two (2) configurable 5-pin XLR outputs for two (2) universes of control.
 8. Provide one (1) USB cable for each DMX interface.
 9. Quantities per schedule. Deliver to Owner.
- J. Provide all accessories as indicated in the Schedule of Quantities. Install monitors at console and deliver all other accessories to Owner.

2.20 SCHEDULE OF QUANTITIES

ARTICLE	DESCRIPTION	QUANTITY SUPPLIED
2.02	Emergency Lighting Interface Devices	Per Specification and Drawings
2.03	Control Interface Rack	Per Specification and Drawings
2.04	Power Conditioners with Battery Back-up	9
2.05	Network System	Per Specification and Drawings
2.06	Nodes – Rack Mounted DMX	As required
	Nodes – Portable DMX – 2 Port	23
2.07	Distributed DMX Drivers	As required
2.08	Control Receptacle Panels	Per Drawings and Schedules
2.09	Architectural Lighting Control Processors	3
2.10	Houselight Panels – LCD	
2.11	Entry Stations	Per Drawings and Schedules
2.12	Production Lighting Cables	Per Specification and Schedules
2.13	Production Lighting Connectors	Per Specification and Schedules
2.14	Control Console	1
2.15	Control Console	2
2.16	Control Processor	2
2.17	Control Console	3
2.18	Control Processor	2
2.19	Monitors – LCD Touch Screen	16
	Monitors – LCD Standard	5
	Monitors – Rack Mounted	5

ARTICLE	DESCRIPTION	QUANTITY SUPPLIED
	Dust Covers	Per Specification
	Storage Media	4
	Keyboard	5
	Uninterruptible Power Supply	4
	Remote video interface	5

PART 3 - EXECUTION

3.01 FABRICATION

- A. Control desks, racks, and cabinets shall be welded assemblies of sheet steel or aluminum or bar size angles, channels, and tees or aluminum extrusions forming rigid enclosures to support internal components.
- B. Operating elements shall be mechanically safe and electrically “dead.”
- C. All steel parts and panels shall be cleaned and primed with rust inhibiting primer. Exterior finishes shall be epoxy resin or baked enamel in matte black, or in Manufacturer’s standard color where not specified.
- D. Control element working face panels shall be steel or substantial aluminum. Legends and control and protective device designations shall be engraved in panels, or in permanently attached plates, and located for ready identification.
- E. All internal wiring shall be factory completed. All wiring shall be in harnesses and bound. No loose or randomly routed wires shall be permitted.
- F. All wire sizes and insulations shall comply with NFPA 70 National Electric Code (NEC), UL, and local codes and meet or exceed electronics industry standards.

3.02 PACKING AND SHIPPING

- A. Equipment shall be wrapped and sealed in polyethylene and substantially crated for shipment. Crates shall clearly indicate equipment contained, nature of components, and site designation.
- B. Dimmers shall be individually packaged.
- C. The equipment manufacturer shall provide notice prior to shipping of shipping method and equipment contained.

3.03 INSTALLATION

- A. All electrical feeds, conduit, and wire shall be provided and installed by Division 26.
- B. All production lighting dimmer racks, distribution, and control devices specified in this Section shall be provided and installed by Division 26.
- C. All receptacles at all distribution devices shall be tested by Division 26 to verify that every circuit has been terminated at the correct dimmer rack, relay panel or panelboard. Circuit corrections, if required, shall be completed prior to Owner training.
- D. All control wire types and topography shall be detailed by the Production Lighting Equipment Manufacturer in the shop drawings. Control wire shall be provided and installed by Division 26. Control wire testing and termination shall be completed by Division 26.
- E. After all painting and dust-creating work is complete and the venue has been thoroughly cleaned, Division 26 shall unpack, assemble, install and test all portable equipment; including consoles, fixtures and accessories specified in this Section.

3.04 SYSTEMS INTEGRATION AND PROGRAMMING

- A. Dealer shall provide addressing for all LED fixtures and any other DMX controlled fixture. Dealer to provide Division 26 contractor a list of DMX address numbers prior to installation of fixtures. At time of commissioning Dealer to patch all DMX controlled fixtures and test to ensure proper functionality.
- B. Dealer, at the direction of Schuler Shook and/or owner’s representative, will adjust all programmable components of the lighting and control system to meet the design intent of the project. Programmable devices include lighting controls (including the layout and design of all touchscreen control panels), addressable lighting fixtures, and user interfaces.
- C. Dealer to plan for a minimum of (6) six hours of dedicated programming time on site with Schuler Shook to program houselights. This time is in addition to any initial time required for system set-up.
- D. Dealer to coordinate any connection to A/V system with A/V contractor and work with A/V programmer to provide desired cross platform functionality.

3.05 PROTECTION AND CLEANING

- A. Provide protection for any production lighting equipment, panels and faceplates installed prior to the completion of construction and painting. Remove any debris or paint from equipment that was not adequately protected. Panels and faceplates not appearing “like new” shall be replaced.
- B. No control consoles, fixtures or accessories shall be installed until construction and painting are complete and the building has been cleaned. Any consoles, fixtures or accessories delivered to the job site prior to their installation shall be stored in a clean area in dustproof bags.
- C. Upon the completion of the work of this Section, dispose of all packing materials, debris and remnants which result from the work of this Section.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Single and duplex receptacles, ground-fault circuit interrupters, integral surge suppression units, and isolated-ground receptacles.
 - 2. Single- and double-pole snap switches and dimmer switches.
 - 3. Device wall plates.
 - 4. Pin and sleeve connectors and receptacles.
 - 5. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.2 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. PVC: Polyvinyl chloride.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc./Hubbell Subsidiary.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Mfg. Company Inc.
 - d. Pass & Seymour/Legrand; Wiring Devices Div.
 - 2. Wiring Devices for Hazardous (Classified) Locations:
 - a. Crouse-Hinds/Cooper Industries, Inc.; Arrow Hart Wiring Devices.
 - b. EGS/Appleton Electric Company.
 - c. Killark Electric Manufacturing Co./Hubbell Incorporated.
 - 3. Multioutlet Assemblies:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Wiremold Company (The).
 - 4. Poke-Through, Floor Service Outlets and Telephone/Power Poles:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.
 - c. Square D/Groupe Schneider NA.
 - d. Thomas & Betts Corporation.
 - e. Wiremold Company (The).

2.2 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.
- B. Straight-Blade and Locking Receptacles: Heavy-Duty grade.
- C. Straight-Blade Receptacles: Hospital grade.
- D. GFCI Receptacles: Straight blade, -through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.
- E. Isolated-Ground Receptacles: Straight blade, Heavy-Duty grade, duplex receptacle, with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.
 - 1. Devices: Listed and labeled as isolated-ground receptacles.
 - 2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
- F. TVSS Receptacles: Straight blade, NEMA WD 6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 - 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.
 - 2. Active TVSS Indication: Visual only with light visible in face of device to indicate device is "active" or "no longer in service."
 - 3. Receptacle Type: Heavy-Duty grade.
 - 4. Identification: Distinctive marking on face of device to denote TVSS-type unit.
- G. Industrial Heavy-Duty Pin and Sleeve Devices: Comply with IEC 309-1.
- H. Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11.

2.3 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 SWITCHES

- A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- B. Snap Switches: Heavy-Duty grade, quiet type.
- C. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 1. Switch: 20 A, 120/277-V ac.
 2. Receptacle: NEMA WD 6, Configuration 5-15R.
- D. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
 1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.
 2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable toggle switch, or slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch wire connecting leads.
 3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless.
 3. Material for Unfinished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless.
 4. Material for Wet Locations: Metallic with spring-loaded lift cover, and listed and labeled for use in "wet locations" as "in-use" type.
 5. All multigang devices to be installed with a single piece common wall plate. Intermixing or splicing of wall plates is not acceptable.

2.7 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular.
- D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

- E. Voice and Data Communication Outlet: Refer to drawings.

2.8 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 1. Service Outlet Assembly: Flush type with four simplex receptacles and space for four SYSTIMAX RJ-45 jacks. Refer to Voice and Data Communication 270500.
 2. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 4. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
 5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 6 SYSTIMAX voice and data communication cables. Refer to Voice and Data Communication 270500.

2.9 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Wire: No. 12 AWG.

2.10 FINISHES

- A. Color:
 1. Wiring Devices Connected to Normal Power System: Black, unless otherwise indicated or required by NFPA 70.
 2. Wiring Devices Connected to UPS: Red, unless otherwise indicated or required by NFPA 70.
 3. Wiring Devices Connected to Emergency Generator: Black with Green Dot, unless otherwise indicated or required by NFPA 70.
 4. TVSS Devices: As selected by Architect.
 5. Isolated-Ground Receptacles: White, with orange triangle on face.
 6. Wall plates (faceplates) General Finished and Unfinished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless, coordinate with Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies level, plumb, and square with building lines.

- B. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions.
- C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.
- D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates. Piecing together single-gang faceplates for multigang installations shall be unacceptable.
- E. Remove wall plates and protect devices and assemblies during painting.
- F. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- G. Install stainless steel faceplates in all food service areas.
- H. Install GFI outlets in locations required by NEC 210.8.

3.2 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
 - 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 26 51 00 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Linear industrial.
4. Recessed linear.
5. Strip light.
6. Surface mount, linear.
7. Suspended, linear.
8. Suspended, nonlinear.
9. Emergency Lighting Units.
10. Exit Signs.
11. Materials.
12. Finishes.
13. Luminaire support.

B. Related Requirements:

1. Section 26 09 23"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 26 09 26"Lighting Control Panelboards" for panelboards used for lighting control.
3. Section 26 09 33"Central Dimming Controls" or Section 26 09 36 "Modular Dimming Controls" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.
4. Section 26 09 43.16"Addressable-Luminaire Lighting Controls" and Section 26 09 43.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
 2. Emergency lighting units including battery and charger.
 3. Ballast.
 4. Energy-efficiency data.
 5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
 6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section "Diffusers, Registers, and Grilles."
 7. Life, output, and energy-efficiency data for lamps.
 8. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Lighting fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 5. Perimeter moldings.
- D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
1. Lamps: Specified units installed.
 2. Accessories: Cords and plugs.

- E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- F. Qualification Data: For agencies providing photometric data for lighting fixtures.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NFPA 70.
- G. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG
- H. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.
- C. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: Ten years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Battery and Charger Data: One for each emergency lighting unit.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. 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.
- B. Standards:
 - 1. ENERGY STAR certified.
 - 2. California Title 24 compliant.
 - 3. UL Listing: Listed for damp location.
 - 4. Recessed luminaires shall comply with NEMA LE 4.
 - 5. User Replaceable Lamps:
 - a. Bulb shape complying with ANSI C78.79.
 - b. Lamp base complying with ANSI C81.61.
- C. CRI of minimum 80. CCT of 4000K.
- D. Rated lamp life of 50,000 hours to L70.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.
- G. Nominal Operating Voltage: 120VAC.

1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

H. Housings:

1. Rolled steel housing and extruded aluminum heat sink.
2. White finish.

2.2 CYLINDER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.
3. Lightolier; a Philips group brand.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.
5. OSRAM SYLVANIA.

B. Minimum 250 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. With integral mounting provisions.

2.3 DOWNLIGHT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.
3. Lightolier; a Philips group brand.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.
5. OSRAM SYLVANIA.

B. Minimum 1000 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Universal mounting bracket.

D. Integral junction box with conduit fittings.

E. Optics:

1. Fixed lens.
2. Medium light distribution.

2.4 LINEAR INDUSTRIAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.

3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. OSRAM SYLVANIA.

B. Minimum 5000 lumens. Minimum allowable efficacy of 80 lumens per watt.

2.5 RECESSED LINEAR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. OSRAM SYLVANIA.

B. Minimum 1500 lumens. Minimum allowable efficacy of 85 lumens per watt.

C. Integral junction box with conduit fittings.

2.6 STRIP LIGHT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. OSRAM SYLVANIA.
5. Philips Lighting Company.

B. Minimum 750 lumens. Minimum allowable efficacy of 75 lumens per watt.

C. Integral junction box with conduit fittings.

2.7 SUSPENDED, LINEAR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.
3. Lightolier; a Philips group brand.

4. Lithonia Lighting; Acuity Brands Lighting, Inc.

5. OSRAM SYLVANIA.

B. Minimum 1500 lumens. Minimum allowable efficacy of 85 lumens per watt.

2.8 SUSPENDED, NONLINEAR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting, an Eaton business.
2. Lithonia Lighting; Acuity Brands Lighting, Inc.
3. Phillips.

B. Minimum 1500 lumens. Minimum allowable efficacy of 85 lumens per watt.

C. Integral junction box with conduit fittings.

2.9 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

3. Master/Remote Sign Configurations:

- a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.

- b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.10 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

2.11 Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.12 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Clear, UV-stabilized acrylic
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Glass: Annealed crystal glass unless otherwise indicated.

4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

1. Rolled steel housing and extruded-aluminum heat sink.
2. White power-coat or painted finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.13 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.14 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated. Install lamps in each luminaire.
- C. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 3. Trim ring flush with finished surface.
- E. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.
 2. Do not attach luminaires directly to gypsum board.
- F. Ceiling-Mounted Luminaire Support:
1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 (6 m) in length.
 2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
 3. Ceiling mount with hook mount.
- G. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
 2. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- J. Adjust aimable lighting fixtures to provide required light intensities.
- K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

3.2 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to 2 visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 27 41 00 – PERFORMANCE AUDIO SYSTEMS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. For the sake of brevity these specifications shall omit phrases such as "(Sub)Contractor shall furnish and install", "unless otherwise indicated or specified", etc., but these phrases are nevertheless implied. Mention of materials and operations requires the (Sub) Contractor to furnish and install such materials and perform such operations complete to the satisfaction of the Systems Designer. Exceptions are noted herein or shown on the drawings.
- B. No representative of the Owner shall have power to waive the obligations of this Contract for the furnishing of good materials or of performing good work, as herein described, in full accordance with the Contract Documents. The failure of any representative of the Owner to condemn any defective work or materials shall not release the obligation to at once tear out, remove, and properly replace the same at any time prior to final acceptance and upon discovery of said defective work or material. However, when requested, the Owner's representative shall observe and accept or reject any material furnished; and in the event the material has been once accepted by the Owner's representative, such acceptance shall be binding on the Owner unless it can be clearly shown that such material does not meet the specifications for this work.
- C. Definitions of terms in this specification section are as follows:
1. "Owner" or "End User" is Tulsa Performing Arts Center
 2. "Architect" is the architect of record for this project, Beck Design
 3. "Systems Designer" is the designer of the systems in this specification section, Schuler Shook.
 4. "Electrical Engineer" is the engineer and designer of the associated electrical systems, Phillips+Gomez
 5. "General Contractor" or "Contractor" is the Construction Manager or General Contractor, or other entity contractually responsible for the construction of the project and the full and proper completion of this specification section.
 6. "Systems Contractor" is the Sub-Contractor, responsible to the General Contractor, who is responsible for performing the scope of work described in this specification section, and in the related contract drawings (see 1.2.B).
 7. "Systems" are the audio, video, control, and network systems described in this specification section and in the related contract drawings (see 1.2.B).
- D. The written specification and the large format audio video drawings are collectively referred to as the contract documents. System components and criteria may be indicated in one location, or possibly in several locations in the contract documents. It is the systems contractor's responsibility to obtain clarification from the Systems Designer, prior to submitting bid documents, if the Contractor believes that there is conflict within the documentation, or if clarification of any kind is required. If the systems contractor fails to obtain said clarification(s), the systems contractor agrees to abide by the interpretation of the Systems Designer, without remedy for additional compensation.

SECTION 27 41 00 – PERFORMANCE AUDIO SYSTEMS

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, other General Requirement Sections, apply to work of this section.
- B. All work shown on Contract Drawings AV series is provided under this section.
- C. Switches, switchboards, contactors, panel boards, transformers, conduit, wire, outlets, connectors and other electrical devices specified herein or on accompanying drawings shall conform to provisions of other sections of Division 26 of the Contract Documents unless otherwise noted. Refer to 1.11 Division of Responsibility Table for additional detailed division of scope.

1.3 SCOPE OF WORK

- A. Work under this section shall include the furnishing of all labor, materials, tools, transportation services, and supervision necessary to complete the installation of the systems and other items as herein listed, all as described in these specifications, as illustrated on the drawings, and as directed by the Systems Designer. Work is comprised of, but not limited to, the following principal Systems:
 - 1. Performance Audio Systems
 - 2. AV Infrastructure
 - 3. Portable AV Systems
 - 4. Portable AV Loose Equipment
- B. The contract documents show design intent and signal flow and are not meant to be fully detailed installation drawings. It is the responsibility of the Systems Contractor to provide fully detailed installation drawings for review and approval by the Systems Designer (see submittal requirements below). It is understood and agreed to by the systems contractor that the work described in the contract documents shall be fully and properly installed and must be a complete and working system per the requirements indicated in these contract documents.
- C. Consistent with the detailed information contained in this specification, it is the responsibility of the systems contractor to supply complete and functional overall systems. Verify complete parts lists, the accuracy of the type numbers and the overall suitability of the equipment to provide functional systems coordinated and interfaced with related work. Provide repeaters, additional switches, and similar equipment as needed for cable length limitations. Other items that are included in the scope of work but may not be fully detailed in the contract documents include, but are not limited to, hardware, rigging devices and supplies, transformers, distribution amplifiers, signal format converters, connectors, patch cords, jumpers, network, or other device SFP modules, and other devices necessary for device interfacing, isolation, installation, or gain structure.
- D. Minor items of equipment needed to meet the requirements stated above, even if not specifically mentioned herein or on the drawings, shall be provided in quality equivalent to other conditions on the project with no claim for additional payment.
- E. Furnish Shop Drawings (see details in Submittals sections below) to the Systems Designer and Architect for review. All purchase of equipment, and/or fabrication or installation work performed without fully approved shop drawings is done so at the Contractor's risk. Any at risk work as described above may be rejected and if

SECTION 27 41 00 – PERFORMANCE AUDIO SYSTEMS

so, all cost associated with the removal of unapproved work, and replacement with approved work is not eligible for reimbursement or additional charge. This includes Division 26 electrical systems and conduit that is required to be provided to support the work described in this section. Conduit drawings related to this scope of work are required to be submitted by the Division 26 sub-contractor, with input and coordination from the Systems Contractor, and approved by the Systems Designer and Electrical Engineer, prior to any of the work described above being performed. Any work done prior to approval of the conduit drawings submittal is at risk and any remedial work or replacement work required by the Systems Contractor and/or Electrical Engineer to correct deficiencies in unapproved work must be performed at the systems contractor's cost and is not eligible for reimbursement or additional charge.

- F. Furnish and install complete Systems with all necessary apparatus and equipment, wiring, etc., required to ensure complete systems in excellent working order as specified herein and on the attached diagrams.
- G. Furnish all back boxes and enclosures for audio video systems panels and control devices, to be installed by Division 26 sub-contractor. Coordinate with Division 26 sub-contractor to verify proper location, orientation, and installation conditions of all back boxes and enclosures to meet project requirements. Refer to 1.11 Division of Responsibility Table and to project documentation for details.
- H. Furnish, install, and terminate all low voltage wire and cable included in this specification section. This does not include AC power system distribution and terminations, except as expressly called out in these specifications or in the audio video drawings.
- I. Systems Contractor is responsible for frequency scanning and coordination of any existing audio video systems devices, or audio video systems devices provided by Owner, with any new wireless transmitters and receivers. Coordinate with Contractor and Owner as necessary accounting for local frequencies already in use by other entities, and accounting for available spectrum. Provide Owner with a complete listing of all wireless equipment referenced above, and the frequencies assigned to the devices, as well as providing a list of available open frequencies for all devices that are tunable.
- J. Systems Contractor must provide Control System and Digital Signal Processing (DSP) system programming and graphical user interface designs, along with any other specialized programming requirements listed or indicated in the drawings, and/or specifications, including specification appendices. Systems Contractor will provide a full set of said programming, fully tested, installed, functioning and ready for inspection prior to Systems Commissioning and Testing. Systems Contractor will then provide a full set of changes, adjustments, and additions to address any deficiencies, or changes requested by the Systems Designer during Systems Commissioning and Testing prior to turnover to the Owner. Systems Contractor will also provide one additional full set of changes and adjustments to meet requests and notes from the Owner during the last third of the initial warranty period. All of this work is part of the base scope of work covered by these contract documents. Changes required to support additional equipment added to the systems during warranty period, that is not part of the work in these contract documents is not included in the work described above. Any such work should be

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proposed to the Owner with the costs for that work for the Owner to approve prior to work being performed.

- K. Perform all initial systems settings and required Systems Contractor testing (see paragraphs 3.10, 3.11, and 3.12 below) and submit all required test reports, and a Declaration of Audio Video Systems Completion.
- L. Provide any required manufacturer training or commissioning (see paragraphs 3.14 below)
- M. Participate, along with manufacturer's representatives (if required), in Systems Designer Commissioning, Testing, and Systems Adjustments.
- N. Remedy all outstanding punch list items prior to Owner training.
- O. Provide training sessions, as required in paragraph 3.14 below, to the Owner's Designated Staff.
- P. Provide systems documentation, as required in paragraph 3.15 below, to the Systems Designer for review and approval.
- Q. Provide systems documentation to the Owner, as required in paragraph 3.15 below, corrected per any notes from the Systems Designer.
- R. Warranty all equipment, components, and workmanship per the warranty requirements in paragraph(s) 1.7 below.
- S. Contract documents for work in this section includes references to supporting work to be provided by other divisions and specification sections. That work is NOT included in this scope of work and is only referenced to show related work to assist in coordination. Refer to the Division of Responsibility Table in paragraph 1.11 for detailed information on division of related labor between sub-contractors. The systems contractor is ultimately responsible for completion of all this scope of work and any related supporting scopes of work.

1.4 JOB CONDITIONS

- A. Verify all conditions on jobsite applicable to this work. Coordinate with scheduled work of other trades. Notify Systems Designer in writing of discrepancies, conflicts, or omissions prior to commencement of work or correct same at Contractor's expense.
- B. The drawings show diagrammatically the cables, conduit, wiring, and so far as possible, the arrangement of equipment, which fit into the spaces available without interference. If conditions exist at the jobsite which make it impossible to install work as shown, prepare and submit drawings to the Systems Designer for approval showing how the work may be installed and, on approval, install the work without additional cost to the Owner.
- C. Contractor and their sub-contractors shall take care not to damage any equipment or to disconnect any wiring other than as required to interface new system. Any contractor-damaged equipment shall be repaired or replaced by the Contractor at no cost to the Owner.
- D. The Systems Contractor must keep the job adequately staffed at all times.

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- E. For no reason other than illness, loss of personnel, or other circumstances completely outside the control of the Systems Contractor, the Project Engineer, Project DSP and Control Systems Programmers, and the Lead Installer shall remain with the project from beginning through completion. In cases where a change must occur, the same pre-bid requirements for CTS-D and CTS-I certification apply to the new staff members, and in anything other than a catastrophic and immediate loss, there must be a minimum of a one week overlap between personnel on the project. The Systems Contractor MUST provide the Systems Designer, notice of any change, including a general reason for the change, and a detailed plan as to how the continuity of information will be achieved. This requirement does not apply to staff other than those directly named above.
- F. The systems contractor is responsible to perform all cutting, patching, and painting or other work necessary to match finish treatments during installation of the systems and to repair any damage done as a result of installation of the systems. The systems contractor is responsible for all cleanup and trash removal from all systems work areas.
- G. The Systems Contractor will cooperate with the Contractor and any or all sub-contractors and the Owner, Owner's Representative, and all other appropriate parties to comply with the overall construction schedule. Watch for conflicts with work by other contractors on the job. Without claim for additional payment, make moderate moves or changes as are necessary to accommodate other equipment or to maintain aesthetic appearance.
- H. The systems contractor will provide and maintain fully finished, dust free and conditioned spaces for all control rooms and rack locations prior to any installation of systems racks or electronics. In addition the systems contractor must provide adequate protection to installed loudspeakers, displays, projectors, cameras, and other systems equipment to protect them from damage and from dust or exposure to other contaminants, such as water or paint overspray.

1.5 SUBMITTALS

- A. Pre-Bid Submittals
 - 1. All Systems Contractors providing bid responses for the systems specified in this section must provide the following documentation for review no later than ten (10) days prior to the bid due date, and must be deemed qualified, in writing, by the Systems Designer.
 - a. A list of projects performed within the last four years of comparable size, and scope (minimum four projects). For each project provide the project name and address, dates of construction start and completion, and a name and phone number for a contact representing the Owner or User.
 - b. A description of the Systems Contractor's facilities used for, and capabilities in the following areas:
 - i. Shop fabrication
 - ii. Rack assembly and wiring
 - iii. Equipment repair
 - iv. Systems servicing
 - v. Creation of CAD, REVIT, or other graphics documentation for shop drawings and as-built drawings

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- c. Resume listing education and experience of the staff member (or members) who will be the project engineer.
 - d. Current CTS-D certificate(s) for the staff member(s) in item c. above.
 - e. Resume listing education and experience of the staff member (or members) who will be the lead installer on-site. The lead installer must be present on-site at all times when installation work is being performed.
 - f. Current CTS-I certificate(s) for the staff member(s) in item e. above.
 - g. A list of any and all proposed deviations or exceptions from the contract Drawings and Specifications. Any deviations or exceptions from the Drawings or Specifications proposed after this time shall not be accepted. These deviations must be formally approved by Schuler Shook.
2. The following Systems Contractors have submitted the required documentation and have been approved to bid:
- a. Skylark AV
229 NW 60th Street
Oklahoma City, OK 73118
John Fones
512-414-9394
john@skylarkav.com
 - b. Brown Note Productions
471 East 124th Ave
Thornton, CO 80241
Zach Richards
303-665-9586
zachr@browwnote.com

B. Bid Submittals

1. Systems contractors must carefully examine all drawings and specifications for this project. No allowances will be made for failure to read and understand all of the project documentation.
2. Requests for clarification during the bid process must be submitted in writing, directed to the proper contact. Do not contact the Systems Designer directly. All requests for clarifications must be made no later than seven (7) working days prior to the bid submission date.
3. Bid proposals must include all of the systems equipment as specified, and all work effort required to engineer and install the systems to meet the specification and drawing requirements. They must also include any other materials, equipment, and labor that may not be shown that is required to deliver a fully functioning and operable systems per the intent of the specifications and drawings.
4. Substitutions of equipment in the design are not allowed during the bid process. The Systems Contractor may provide alternative equipment as options in their submittal, but they must provide a complete bid response based on the systems as designed, with the options shown separately (See 1.5.B.6.e below). Any of the alternate equipment shall have been formally pre-approved ten (10) days prior.
5. The scope of work indicated in this specification and the AV drawings must be performed by the Systems Contractor and may not be sub-contracted or assigned to others unless the following requirements are satisfied:
 - a. Any and all sub-contractors must be bound by the terms of this specification including bidding and qualification requirements and must agree to this in writing as part of the bid response package.

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- b. The names of all proposed sub-contractors and a statement of their qualifications (see 1.5.A.1 in its entirety above) must be included in the bid response package.
- 6. All bid response packages must include the following information, in its entirety, or they will be rejected, in whole, as unresponsive:
 - a. An itemized list of all equipment and materials to be used in the installation of the systems in this scope of work. This list must include a short item description, item name, and manufacturer's name, quantity of items included, and a unit price for that item. Lot prices may be used instead of unit prices only for miscellaneous items not included in the list of specified equipment. Any manufacturer quotes referenced in the equipment list in this specification section must be broken out into unit descriptions as described above.
 - b. A labor breakdown as follows:
 - i. Pre-installation engineering (includes shop drawings and other documentation as well as submittals)
 - ii. Coordination meetings, site coordination, and supervision
 - iii. Shop engineering and assembly
 - iv. Shop programming time
 - v. Site installation work
 - vi. Site programming time
 - vii. Systems Contractor verification of systems
 - viii. Systems Designer commissioning and tuning
 - c. Total contract price for the base project as designed
 - d. Total contract price for any pre-approved alternate system as designed
 - e. For each of any proposed options provide the following:
 - i. Itemized list of equipment from the design that will be replaced by the option with the same information required in 1.5.B.6.a above.
 - ii. Lump sum labor cost attached to the list of equipment from the design that will be replaced by the option.
 - iii. Itemized list of equipment that will replace the equipment listed above in item I, with the same information required in 1.5.B.6.a above.
 - iv. Lump sum labor cost attached to the list of equipment from the option.
 - v. Total Add or Deduct amount from the Base Bid if this option is selected.
- C. Pre-Installation Submittals
 - 1. The following guidelines must be adhered to for all submittals to be reviewed:
 - a. All shop drawings must be sized such that the paper size matches that of all other project construction drawings. All drawings must be legible when printed at ½ actual size.
 - b. Drawings should be done in black and white. Color may only be used to indicate specific signal types in single-line drawings, but in that case, they must still be legible with all information clearly seen if printed in black and white.

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- c. Drawings and all other submittal documentation should be provided in PDF format. DWG files and Revit models must be provided upon request. All drawings shall be produced in AutoCAD or Revit or in a compatible software that can produce accurate files that are compatible with AutoCAD or Revit.
 - d. Submittal of contract drawings, or copied portions of contract drawings as shop drawings is not allowed and they will be rejected. Use of electronic files generated by other parties (Systems Designer drawings or architectural backgrounds, for example) does not release the Systems Contractor from the responsibility to provide accurate, fully engineered, coordinated, and functional systems and complete solutions. The Systems Contractor must provide systems that meet or exceed all contract document requirements.
 - e. All revised submittals must include a revision number and date. All changed drawings or documents must clearly indicate the revision number and date, and all changed items must be clouded and tagged with the revision number. All subsequent revisions must have prior revisions clouds and tags removed for clarity. Drawings or documents included in a revised submittal that have NOT changed must not be marked as revised. Revisions that are not properly tagged may not get reviewed. This does not release the Systems Contractor from the responsibility to provide all revisions as are indicated in submittal responses.
 - f. All submittals must reflect the project awarded, as a whole, including all Owner accepted add/deduct alternates, all Systems Designer approved, Owner accepted Systems Contractor options proposed at bid, and all Systems Designer approved, Owner accepted post-bid, pre-installation, Systems Contractor proposed substitutions.
2. Every Submittal must include, as the first sheet, a table of contents of what all is provided within that particular submittal.
 3. Submittal submissions must follow the following schedule:
 - a. Within 30 days of award the Systems Contractor must provide work effort documentation that includes:
 - i. List of activities that require coordination with the Owner
 - ii. List of activities that require coordination with the Architect
 - iii. List of activities that require coordination with the Systems Designer
 - iv. List of activities that require coordination with the Contractor and other trades.
 - v. List of all key procurement items and drop-dead dates for procurement and delivery to maintain schedule.
 - vi. Schedule indicating all of the items listed in items a. through e. above and indicating critical path.
 - vii. All activities related to coordination listed in a. through d. above must be examined and agreed upon by all other parties prior to submittal.

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- b. Within 30 days of award the Systems Contractor must submit all post-bid, pre-installation period substitution requests per the following requirements:
 - i. Substitutions may only be incorporated into the design upon acquiring written consent and stamped approved substitution submittal documents from the Systems Designer.
 - ii. Substitution products/systems must be equivalent or better than specified products/systems in quality, performance, function, warranty, and conformance to system requirements.
 - iii. After the 30 day period mentioned above, the only Systems Contractor proposed substitutions that will be reviewed for approval are those required to replace discontinued products or products that cannot be procured in time to avoid project delays.
 - iv. No substitution may be approved without providing the following information for review:
 - a) List of any advantages to the Owner
 - b) List of any disadvantages to the Owner or lost functionality, whether that functionality is required by the systems design or not.
 - c) Printed specifications and/or laboratory test data for the substitution product AND the original product.
 - d) Description of previous field use and successes and failures.
 - e) Global cost savings reflecting total cost of equipment and labor and other costs incurred by changes in other Contractor's scope of work to support the substitution.
 - f) Unit price of each proposed item, and of the item being replaced.
 - g) In rare instances, the Systems Designer may request a sample of a proposed substitution for evaluation to determine acceptability as a substitute. In this situation, the Systems Contractor will procure and ship the sample to the Systems Designer, at the Systems Contractor's cost. The Systems Designer will evaluate the sample and then return it to the Systems Contractor. If the Systems Designer agrees, the sample may be provided by the manufacturer directly, at their cost, for evaluation.
 - v. The Systems Designer is the only party that may determine if a proposed substitution is acceptable. If the Systems Designer determines that the substitution is not acceptable, the Systems Contractor must provide the specified product from the contract documents.
 - vi. Where a substitute material or method is approved, the systems contractor must make all changes to accommodate

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- the substitution with no claim for additional payment beyond that included in item iv. e) above.
- vii. The Systems Designer reserves the right to substitute new products for products specified in the contract documents provided there is no material cost increase to the Contractor and the Contractor has not purchased the originally specified equipment.
 - c. Within 30 days of award the Electrical Contractor and Systems Contractor must provide the conduit riser diagrams submittal. This submittal is the responsibility of the Electrical Contractor to create and submit, with input from the Systems Contractor. Any conduit installed prior to receiving a stamped approval of the riser submitted is at risk, and if it is found to be deficient, it must be removed and properly installed per specifications and per the approved riser, at the sole cost of the Contractor.
 - d. Within 30 days of award the Systems Contractor must provide the following in a single PDF format document:
 - i. Itemized list of all equipment and materials to be used in assembling the system.
 - ii. Catalog cut sheets or data sheets for each listed item.
 - a) Product data sheets must not be web page captures of specifications, unless there is no other recourse.
 - b) Product data sheets with multiple options or part numbers must clearly be marked with the selection to be used for this project. All options must be called out. Anything the Contractor is not supplying that is shown on the sheet must be called out as an exclusion.
 - e. Within 30 days of award the Systems Contractor must provide the following in a single PDF format document:
 - i. Plan and RCP drawings indicating the location of equipment and termination panels.
 - ii. A complete list of all cabling, wire by wire. Each entry in the list must include the unique wire number for that cable, and the termination locations of each end
 - iii. Detailed 3-wire schematic diagrams for any custom circuitry
 - iv. Detailed 3-wire schematic diagrams for typical connections between audio lines, patch bays, and rack mounted equipment.
 - v. Drawings of any custom items in a scale suitable for fabrication. The drawings must detail materials, colors, finishes, and any lettering or other markings. All lettering must be shown in the size and typeface to be used. These drawings include custom plates, rack panels, termination plates and any other custom manufactured equipment.
 - vi. All custom panels in the direct view of the general public may require a custom finish. Provide a list of all panels in the direct view of the general public and their location so that the architect may respond with any custom finish requirements. The Architect may request samples of each

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custom finish required. The Contractor must provide these samples to the Architect upon request, for approval. Costs for the samples and shipping the samples to the Architect shall be the sole responsibility of the Contractor. Submitted samples will not be returned.

- vii. Rack elevation drawings indicating equipment locations within the rack, power distribution and any cabling routing information. Elevate the front and rear of all racks. Notate any equipment in the rack that must have a security cover, per the rack specifications below.
 - viii. Patchbay layout drawings at 1:1 scale showing labeling and indicating any normal connections and the type of normal connection.
 - ix. Mechanical drawings showing mounting and/or rigging of all permanently installed AV Systems equipment, including but not limited to projectors, projection screens, displays, loudspeakers, cameras, and other AV devices that mount to architecture or structure. Additionally provide drawings for any permanently installed mounting plates designed to support portable AV systems equipment. Any mounting systems that are not provided as a single manufactured product from a single approved rigging and mounting manufacturer must be a fully engineered solution, must be approved in concept by the Systems Designer, and each drawing sheet must be stamped by a licensed structural engineer selected by the Contractor. Each custom solution must be shown separately and verified and stamped independently.
- f. Within 30 days of award the Systems Contractor must provide the following in a single PDF format document:
- i. In coordination with the Owner's IT department, provide a networking plan for the AV systems networks. This plan must include:
 - a) Narrative description of the network design and function including but not limited to information describing all LAN's, VLAN's, and QOS plan.
 - b) Physical network diagram
 - c) Logical network diagram
 - d) IP Address table and addressing protocol, including fixed IP addresses for all AV systems devices. This document must be updated for the as-built submittals to indicate the corresponding MAC address for each device.
 - ii. Provide a written plan for EDID and HDCP management for all video signals and interconnection between devices.
- g. Within 60 days of award the Systems Contractor must provide the following in a single PDF format document:
- i. A mockup of all graphical user interface screens for touchpanels, computer displays, portable devices and any other display format, including but not limited to all

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- loudspeaker control software, Digital Signal Processing software, Video routing and switching software, and control systems software.
- ii. Source code and configuration files for any and all devices, as required for proper systems operation.
- h. Every two weeks after award, the Systems Contractor must provide to the Contractor and Owner a progress report that includes:
 - i. Overall status of the project and work completed by percentage
 - ii. Schedule changes
 - iii. Detailed Three week work plan
 - iv. Procurement updates:
 - a) Procurement problems
 - b) Concerns needed to be addressed by others
 - c) Value of materials procured and stored on site, or if allowed, in the Systems Contractor facility as a dollar value and a percentage of total project materials cost.
 - v. List of outstanding submittals indicating document number and date of submittal, in order from most recent to first submittal.
 - vi. List of outstanding RFI's indicating document number and date of submittal, in order from most recent to first submittal.
 - vii. Indicate any items in v. and vi. above that are overdue and whether or not they are affecting schedule. If they are affecting schedule provide information as to why and how they are affecting schedule.
- i. 30 days prior to any equipment purchase the Systems Contractor must request line item authorization from the Systems Designer to purchase equipment. This is to avoid procurement of equipment that may already be outdated by the time of procurement. The Systems Designer shall respond to the Systems Contractor within 15 days of receipt of the procurement request with approvals and/or replacement products. There will be no allowance for schedule extension based on this requirement.
- j. At completion of installation and Systems Contractor testing (see 3.10, 3.11, and 3.12 for testing requirements), the Systems Contractor must provide the following in a single PDF format document:
 - i. Written Statement of Completion that verifies the installation is 100% complete and has been tested as required, and is ready for the Systems Designer to perform testing and commissioning of the systems.
 - ii. A Testing Report that includes:
 - a) ALL test data from all tests, including failed tests and subsequent passing tests after rectifying the problem that caused failure
 - b) Usage of any spare cabling to replace cabling that was damaged during installation. Include the wire

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- numbers of the failed cable and the spare used to replace it.
- c) A listing of any and all portable equipment, cabling, racks, etc. that is not located on site, a reason for that, and a date as to when it is expected on site.
- k. Within 30 days of completion of Systems Designer testing and commissioning, Owner training, delivery of any missing equipment, and resolution of any and all punch items including software programming changes, the Systems Contractor must provide the following on five separate USB storage devices (three to the Owner, and two to the Systems Designer):
 - i. Systems Documentation:
 - a) Table of contents
 - b) Written Guarantee and service policy
 - c) Copies of all shop drawings which have been updated to include any changes made during the installation process.
 - d) Single-line signal diagrams identifying all cable runs and patchbay points with the associated cable number
 - e) Complete Systems Contractor Testing report
 - f) Complete and updated conduit riser diagram to match installed conduit.
 - g) Final system settings for all settings adjusted during Systems Designer testing and commissioning
 - h) Updated network documentation as listed above
 - i) All updated and current system software files, source code, GUI designs, and any other software files for all of the AV Systems
 - j) All available manufacturers' operation and service literature for each major system and system component.
 - k) Systems operational procedures including power on sequences, power off sequences, recovery from power failure sequences, emergency procedures, and any other procedures needed to operate the systems properly in any and all states.
 - l) In addition to the above, provide to the Owner, two printed copies of items j) and k) above.
 - m) In addition to the above, provide to the Owner one laminated copy of each sheet of each Single-Line signal diagram for each venue as per item d) above.

1.6 QUALITY ASSURANCE

- A. All parts shall be provided complete per manufacturer's specifications and with all necessary accessories required to meet the intent of the design and provide fully functional systems, including but not limited to any mounting devices, software licenses, SFP modules, etc.

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- B. All materials shall be new and shall meet or exceed all applicable requirements and standards of Underwriters Laboratories and the American Standards Association.
- C. Systems Contractor is responsible for obtaining and paying for all permits, licenses and inspections, for meeting any requirements of permits and licenses, and for remediating any work called out as incorrect or not meeting code or other standards during inspections.
- D. Systems Contractor must act in accordance with applicable federal, state, local, and union labor regulations.
- E. Installation shall conform to latest federal, state and local electrical and safety codes or those of other authorities having jurisdiction (AHJ). Where conflicts exist, the most stringent code or regulation shall apply.
- F. If additional work by the Systems Designer is required as a direct result of deviations from approved drawings and specifications during construction, the systems contractor will be liable for those additional costs that the Owner may incur.
- G. Government Standards: The Systems Contractor is to comply with all government regulations, standards, and laws that apply to the installation and use of the AV equipment and/or other scope of work specified in this section. The following agencies have laws and rules that apply:
 - 1. Federal Communications Commission (FCC): FCC rules are located in Title 47 of the Code of Federal Regulations. The following is a partial list of the FCC regulations that apply to equipment specified in this section of work:
 - a. Part 15: Radio frequency devices
 - b. Part 22: Public mobile services.
 - c. Part 24: Personal communications services.
 - d. Part 25: Satellite communications.
 - e. Part 27: Wireless communications service.
 - f. Part 51: Interconnection.
 - g. Part 74: Experimental radio, special broadcast, and other program distribution services.
 - h. Part 95: Personal radio services.
 - 2. Occupational Safety and Health Administration (OSHA) – Follow all applicable standards for health and safety particularly sound pressure level exposure.
 - 3. ANSI Standards: American National Standards Institute (ANSI) standards cover safety, fabrication, assembly, installation, rigging, equipment handling, and testing.
 - 4. Contributing Organizations – The Organizations listed below have published standards used to establish the technical references to be followed under this scope of work.
 - a. Acoustical Society of America (ASA) (ASC S1)
 - b. Alliance for Telecommunications Industry (ATIS) (ASC T1)
 - c. American Society of Safety Engineers (ASSE) (ASC A1264)
 - d. Audio Engineering Society (AES) (ASC S4)
 - e. Electronics Industry Alliance (EIA) (CEMA)

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- f. Entertainment Services and Technology Association (ESTA) (ASC E1)
 - g. Institute of Electrical and Electronics Engineers (IEEE) (ASC C136) (802.1)
 - h. International Cable Engineers Association (ICEA) Formerly IPCEA
 - i. International Standards Organization (ISO)
 - j. National Electrical Manufacturer's Association (NEMA) (ASC C119)
 - k. National Fire Protection Associations (NFPA)
 - l. National Safety Council (NSC) (ASC A10)
 - m. Photographic and Imaging Manufacturer's Association (PIMA)
 - n. Society of Motion Picture and Television Engineers (SMPTE)
 - o. Telecommunications Industry Association (TIA)
 - p. Underwriters Laboratories (UL) (ASC C101) (CE)
 - q. NTSC
 - r. BICSI
 - s. National Association of Broadcasters (NAB) – System technical standards for video and RF compliance are listed in the most recent edition of the NAB Handbook
5. Safety Standards – Contractor will adhere to the following Safety Standards for all work identified in Division 27 41 00 and as part of the General and Supplementary sections of the Division-1 Specifications.
- a. ANSI A14.2-2000: Safety Requirements for Portable Metal Ladders
 - b. ANSI A14.7-2000: Safety Requirements for Mobile Ladder Stands and Mobile Work Platforms.
 - c. ANSI C2-2002: National Electrical Safety Code
 - d. ANSI Z136.1-2000: Safe Use of Lasers and laser systems
 - e. ANSI Z136.2-1997: Safe Use of Optical Fiber
 - f. ANSI Z359.1-1992 (R1999): Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
 - g. ANSI/PIMA IT7.101-1999: Recommended Practice for the Safe Handling and Operating of Audiovisual Equipment.
 - h. IEEE 142-1991: Grounding of Industrial and Commercial Power Systems
 - i. UL 514A: Scrub Water exclusion from AV Floor Boxes
 - j. UL 1419-1995: Standard for Safety for Professional Video and Audio Equipment
 - k. in accordance with the National Electrical Code, ANSI/NFPA 70
 - l. UL 1492-1994: Standard for Safety for Audio-Video Products and Accessories
 - m. UL 1651-1997: Standard for Safety for single and multiple Optical Fiber Cable
 - n. UL 1667-1996: Audiovisual Systems Safety Standard for Tall AV Institutional Carts for use with Audio, Video, etc.
 - o. ANSI E1.1-1999: Construction and Use of Wire Rope Ladders to prevent most injuries
 - p. ANSI A10.8-2001: Safety Requirements for Scaffolding
 - q. ANSI A10.42-2000: Rigging Qualifications and Responsibilities
6. Applicable Performance Standards – Execute all Division work in accordance with the following standards:

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- a. ANSI S4.48-1992 (R1998): Recommended Practice for the Application of Connectors, Part 1, XLR-Type polarity, and gender
- b. ANSI S4.55-1997: Recommended Practice for conservation of the Polarity of Audio Signals
- c. ANSI S4.56-1997: Recommended Practice for the subjective evaluation of Loudspeakers
- d. ANSI S12.2-1995 (R1999): Criteria for Evaluating Room Noise
- e. ANSI T1.217-1991 (R1998): Integrated Services Digital Network (ISDN)
- f. Management –Primary Rate Physical Layer
- g. ANSI T1.522-2000: Quality of Service (QOS) for Business Multimedia Conferencing. Specifies classes of Service for conferencing on IP Networks
- h. AES15: ANSI S4.49: AES Recommended practice for Sound Reinforcement Systems –Communications Interface PA-422.
- i. AES-R1-1997 AES project report for professional audio: Specifications for audio on high capacity media
- j. AES14-1992 (r1998) AES standard for professional audio equipment -- Application of connectors, part 1, XLR-type polarity and gender
- k. AES24-1-1999, (Revision of AES24-1-1995) AES standard for sound system control - Application protocol for controlling and monitoring audio devices via digital data networks
- l. AES26-2001 (Revision of AES26-1995) AES recommended practice for professional audio -- Conservation of the polarity of audio signals
- m. ANSI/TIA/EIA 606-1993: Standard for the Telecommunications Infrastructure of Commercial Buildings
- n. ANSI/TIA/EIA 607-1994: Commercial Building Grounding and Bonding Requirements for Telecommunications
- o. IEEE 149-1979 (R1990): Test Procedure for Antennas
- p. IEEE 1100-1999: Powering and Grounding Sensitive Electronic Equipment
- q. NEMA 250-2001: Enclosures for Electrical Equipment
- r. SMPTE 292M: SMPTE 292M defines the base 1.485Gbps HD-SDI. Note: This standard can handle all HD formats except 1920*1080 @ 50P and 60P.
- s. SMPTE 372M: Uncompressed Dual-Link HD-SDI for 50P & 60P
- t. SMPTE 424M: 2.97 Gbps HD-SDI for 50P & 60P
- u. TIA/EIA-568-B: Digital audio over Cat5 audio cable
- v. UL 1047-1999: Isolated Power Systems Equipment
- w. UL 1581-1998: Reference Standard for Electrical Wires, Cables, and Flexible Cords
- x. UL 1682-1998: Standard for Safety for Plugs, Receptacles, and Cable Connectors, of the Pin and Sleeve Type up to 800 Amperes and up to 600 volts ac or dc.
- y. UL 467-1998: Grounding and Bonding Equipment
- z. UL 813-1999: Commercial Audio Equipment and accessories for use in commercial enterprises

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- aa. ANSI/TIA/EIA-568-A: Commercial Building Telecommunications Cabling
- bb. ANSI/TIA/EIA-569-A: Commercial Building Standard for Telecommunications Pathways and Spaces
- cc. ANSI/TIA/EIA-607: Commercial Building Grounding and Bonding Requirements for Telecommunications
- dd. ANSI/TIA/EIA TSB-72: Centralized Optical Fiber Cabling Guidelines
- ee. ANSI/TIA/EIA-526-14A: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
- ff. ANSI/TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Single mode Fiber Cable Plant
- gg. ANSI/IEEE C-2 National Electrical Safety Code how to install cabling in accordance with the most recent edition of BICSI® publications:
 - i. BICSI Telecommunications Distribution Methods Manual
 - ii. BICSI Cabling Installation Manual

1.7 WARRANTY AND WARRANTY SERVICE REQUIREMENTS

- A. All systems devices shall be guaranteed free of defects in materials and workmanship for a minimum period of one year and for a maximum period not to exceed the length of the manufacturer's warranty. All workmanship will be guaranteed free of defects for a period of one year. These warranty times begin on the date the Systems Designer accepts the systems as complete.
- B. The Systems Contractor will provide the Owner with an emergency service request phone number that will be answered twenty-four hours a day, 365 days a year. See response times below.
- C. In a non-emergency situation, defective devices shall be repaired or replaced within forty-eight hours following the report of such defects by the owner, and telephone calls must be responded to within one business day.
- D. Many of the systems installed as part of this scope of work are critical to the operation of the facility. As such it is mandatory that the following replacement and response times be strictly adhered to in a Qualifying Emergency Event. Qualifying emergency events are defined as events that may cause severe hardship or cause the systems to be inoperable or unusable for a scheduled class or event. In an emergency event:
 - 1. The Systems Contractor must respond to telephone calls within one hour. The personnel answering this call must be fully qualified to troubleshoot problems and propose solutions.
 - 2. If the situation requires a site visit, The Systems Contractor must have personnel on-site within eight hours of the phone call determining the need.
 - 3. If corrective measures on-site are required, they will be performed within twelve hours of the determination of a need for a site visit.
- E. If, during the warranty period, any component is out of service for more than seven days due to unavailability of parts or service, systems contractor shall supply and install an identical new component. If an identical component is not available,

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systems contractor will substitute equivalent equipment, with the approval of the Owner.

- F. Repeated device failures, defined as the failure of a device or a single type of device three or more times over three contiguous months, will be considered as a failure of a manufactured system and all items of this type shall be replaced at no charge to the Owner.
- G. During the course of the warranty period, the systems contractor shall provide a minimum of three (3) service visits to the site for inspection and adjustment of equipment. Systems contractor shall submit proposed schedule for these visits and shall notify Owner and Systems Designer in writing at least one month in advance of each visit.
- H. During the warranty period, the Systems Contractor will supply the Owner with any published updates of manufacturer provided operating software and firmware for any and all software-controlled equipment that are issued to correct “bugs”. During the warranty period, the Owner will rely on the Systems Contractor to determine when to update the software and/or firmware, unless it is needed to correct a situation that renders the systems unstable, non-functional, or otherwise affects operations.
- I. At least one representative of the Systems Contractor, well versed in the installation and the operation of the systems, shall be on site in support of the Owner for the first significant public event in each venue (as determined by the Owner) where the system will be used. The Contractor representative(s) for this event shall also be competent in show operations.
- J. The systems contractor is to coordinate ongoing remote access to AV Systems Networks for support and troubleshooting. Owner to provide the access at their discretion.

1.8 PERMIT

- A. Obtain all permits necessary for the execution of any work pertaining to the installation, and conform in all trades with all applicable codes/regulations. Obtain all permits necessary for operation of any equipment by the Owner, including but not limited to laser projectors and radio systems.

1.9 INSURANCE

- A. All equipment and materials shall be fully insured, by the Systems Contractor, against loss or damage up until acceptance of the system by the Owner or until Owner relieves the Contractor in writing of this responsibility, whichever is earlier, regardless of the location of the equipment. All equipment is deemed to be under the control of the Systems Contractor until acceptance of the system by the Owner or until Owner relieves the Contractor in writing of this responsibility, whichever is earlier.

1.10 EXISTING CONDITIONS

- A. For projects including renovation work on existing facilities, visit the site prior to making a bid. No subsequent allowance will be made due to failure to thus observe

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and verify conditions which may affect the work. Report to the Architect and Systems Designer any discrepancies among this specification and existing conditions and similarly report obvious omissions.

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1.11 DIVISION OF RESPONSIBILITY TABLE

ITEMS PROVIDED AND INSTALLED	Electrical Contractor Provide	Electrical Contractor Install	Systems Contractor Provide	Systems Contractor Install
Main Power Panel Boards and Circuit Breakers	X	X		
Audio Video Isolated Ground Power (AVIGP) Transformers	X	X		
AVIGP Isolated Ground Conduit, and Conductors	X	X ¹		
AVIGP panel boards and circuit breakers	X	X		
AVIGP standard load centers and circuit breakers	X	X		
AVIGP Company Switches	X	X		
Audio Video Systems Equipment Racks, Termination Panels, and Audio Video Devices				
- Racks			X	X
- Termination Panels			X	X
- Termination Panel Back Boxes		X ¹	X	
- Termination Panel Floor Boxes		X ¹	X	
- All conduit, J-Boxes, Cable Sleeves, Ladder Tray, Mounting Hardware for Audio Video Systems Signal and Control Cabling	X	X ¹		
- Conduit Isolation Bushings at Racks	X	X		
- Audio Video Cabling			X	X
- Audio Video Cabling Termination			X	X
AVIGP Branch Circuits for Systems Equipment Racks going to:				
- In Wall Outlets	X	X		
- Ladder Tray Mounted Outlets	X	X		
- Ceiling Mounted Outlets	X	X		
- In Rack Power Distribution Devices		X ²	X ²	
Audio Video Systems Conduit Riser Diagram Submittal	X ³			

Note 1: Installation criteria and coordination provided by Systems Contractor

Note 2: Rack Power Raceways are provided and installed by the Systems Contractor. The branch circuits are installed and terminated to the raceway by the Electrical Contractor. Care must be taken to maintain the isolation of the rack and its contents from building ground.

Note 3: The Conduit Riser Diagram is developed by the Electrical Contractor with criteria provided by the Systems Contractor. This is a critical submittal. Any conduit installed prior to approval is at risk and any replacement, remediation, or repairs required to meet specifications will be performed at systems Contractor's cost.

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PART 2 - EQUIPMENT

2.1 GENERAL EQUIPMENT

- A. All equipment specified by manufacturer and model number is done so for the purposes of establishing a standard of quality, performance, construction and function.
- B. All materials and equipment shall be of the latest design or model offered for sale by the manufacturer.
- C. All equipment will be new and be supplied with a full manufacturer's warranty.
- D. The equipment provided shall operate at the required AC line voltage and frequency for the available power supply.
- E. Contractor shall provide quantities as indicated in the specifications, specification appendices, and in the large format AV drawings. Where quantities appear to differ, the Contractor must request clarification from the Systems Designer.
- F. Audio & Video Wire and Cable
 - 1. All wire numbers listed in the drawings are Windy City unless otherwise noted.
 - 2. THHN wire is not an allowable substitute for twisted pair stranded loudspeaker wiring.
 - 3. Approved manufacturers: Belden, Canare, Gepco, West Penn, Whirlwind, Windy City.
 - 4. Where conflict exists with any codes or ordinances, such codes and ordinances shall take precedence.
 - 5. Where conflict exists with electrical specifications, the higher standard or more stringent requirement shall apply, at the discretion of the Systems Designer or AHJ.
- G. AV System Plates and Panels:
 - 1. Rack Mount Panels shall be constructed of 11 gauge steel or 1/8" Aluminum, minimum thickness. Finish shall be black or match adjacent equipment. The panels shall be 19" wide with standard EIA mounting hole spacing. Height as specified.
 - 2. Back Box Enclosures shall be code grade steel. Black, Galvanized, or Stainless Steel (for NEMA4 or 4X). Size as specified.
 - 3. Plug Box and Termination Panels shall be constructed of 11 gauge steel or 1/8" Aluminum, minimum thickness. Finish shall be black (unless instructed otherwise by Architect – see 1.5.C.3.e.iv. Size as specified. Approved Manufacturers: Steel City, Raco, Hoffman, Whirlwind, Pro Co, Wireworks
 - 4. Engraved lettering is white paint filled engraving on black anodized panel unless it is a custom color panel in which case, confirm lettering color with Systems Designer. Lettering is to be upper case, 14 point, Arial. Where spacing is critical, reduction to 12 point is allowed.

2.2 MAJOR EQUIPMENT

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- A. Equipment provided shall be that specified herein or approved substitute (see Paragraph 1.5.C.3.b).
- B. Detailed performance specifications shall be those published by the manufacturer effective on the date of this document for all equipment listed.
- C. See Major Equipment List in Appendix B.

2.3 DETAIL DRAWINGS

- A. The drawings herein may detail custom built equipment and system details.
- B. Furnish all materials and labor to provide complete and finished work even though not specifically shown on the drawings.
- C. Detail drawings are located in large format AV drawings.

PART 3 - EXECUTION

3.1 AUDIO VIDEO SYSTEM REQUIREMENTS

- A. Requirements herein refer to materials and work which are related to or part of the Systems. Where conflict exists with other specifications concerning such work or materials, this specification takes precedence unless otherwise approved in writing by the Architect.

3.2 AUDIO VIDEO SYSTEMS INSTALLATION

- A. All equipment must be installed in such a manner and in locations that allow for access for maintenance and repair. Equipment racks must be placed in the rack rooms to permit full access for operation and service.
- B. Furnish and install all necessary brackets, braces and supports. All mounting hardware shall be included. AV devices may require additional support and/or backing in stud walls or ceilings to support the weight of the device. Contractor must furnish and install all support and backing as necessary for proper and safe installation.
- C. All bolts and fasteners must be Grade 5 or better.
- D. All bolted attachments to have lock washers or other self-locking fasteners.
- E. Provide all required mounting brackets and framing, hardware and components, safety systems and rigging systems using the following minimum design factors (given as ratio of working load limit (WWL) : rated breaking load):
 - 1. 5:1 – Minimum design factor for all mounting components regardless of mounting condition.
 - 2. 5:1-8:1 – Minimum design factor for manufacturer provided mounts & assemblies where engineered stamped documentation and destructive testing data is provided by manufacturer.
 - 3. 10:1 – For all hardware and connecting assemblies between manufacturer rated assemblies when equipment is hung above the general public. This includes but is not limited to wire rope, bolts, shackles, turnbuckles, beam

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- clamps, supplemental steel provided by Systems contractor and other connecting hardware.
4. Design factor calculations to be provided with all equipment mounting details.
 5. Systems Contractor shall coordinate required additional blocking, supplemental steel or channel strut supports with Main Contractor & specific trade contractors.
 6. All mounting systems not provided as a complete package from a single manufacturer must be engineered, approved, and have drawings stamped by a professional rigging engineer or licensed structural engineer, as approved by the Main Contractor. The engineer shall verify that the design meets or exceeds design criteria for this particular use case. Each mounting system solution must be separately engineered, verified, and stamped.
- F. All supporting structures and enclosures supplied by the systems contractor not having a standard factory paint finish shall be painted. Paint specifications will be supplied by the Architect or indicated herein.
- G. Provide custom color or finish for any equipment, panels, or materials supplied which are in public view. This does not exclude equipment or materials where standard colors and finishes may be specified herein. Request information on color and finish from the Architect.
- H. Finish of blank panels and custom assembly panels shall match adjacent equipment panels. All color choices should be clearly indicated on panel drawing submittals, and on the panel schedule submittals
- I. Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched or screened. Markings for these items are detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Systems Designer prior to marking.
- J. Protect equipment and related wiring where construction conditions may cause damage or environmental conditions exceed manufacturer's specifications.

3.3 CONDUIT

- A. Review and coordinate Systems conduit installation with the electrical contractor to ensure proper operation of the Systems. Provide input to the electrical contractor so that they may complete the AV conduit riser submittal.
- B. All wiring shall be in conduit unless authorized by the Architect, approved by the Systems Designer, and permitted by code. Exceptions are short runs at rack terminations where there is no means of connecting conduit to the equipment.
- C. Where installed exposed, conduits shall be parallel with or at right angles to walls or ceilings and shall be supported from walls or ceilings by means of approved galvanized iron clamps or hangers. Conduit connections to equipment racks shall be insulated in order to maintain ground isolation.
- D. Minimum size conduit shall be 3/4 inch. All conduit shall be sized for a maximum 40% fill, unless applicable codes require a lower maximum fill

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- E. No conduit run between pull boxes/termination boxes may exceed 100 feet in length, and no single turn may exceed 90 degrees.
- F. No conduit run shall have more than 180 degrees of combined turns between pull boxes.
- G. Conduit containing STP, UTP, and COAX wire types must be installed so that the final length of the cable runs does not exceed maximum cable lengths as stated in 3.7.N and 3.7.O.
- H. Systems wiring is divided into wiring groups according to their nominal voltage levels. Cabling may be combined in a single conduit, and/or junction box(es) as long as all cables are of the same wiring group. Refer to the Major AV Drawings General Information sheet for information on conduit separations by cable type. Refer to major AV drawings Terminations Schedule for cabling, grouping, and destination details, by termination):
- I. All conduits, within 6” of termination box, junction box, gutter or rack/ ladder tray, must be labeled with conduit group and destination of the opposite end of that conduit, as follows: “AV -<Group>- <opposite end>”. For example “AV – III – STGA-01”. Permanent marker on the conduit where it can be seen from the ground or nearest access point is acceptable.
- J. Each termination does not require individual home run conduits. Conduits of like groups may be combined at junction boxes so that a smaller number of larger conduit sizes may be used instead of a larger quantity of smaller individual conduits.
- K. Electrical contractor must have written authorization from the Systems Designer for any conduit installation which does not conform to these requirements. The conduit separations above are based on the use of EMT conduit for all AV and other signals. Separations where Rigid conduit is utilized for AV systems and/or other adjacent systems may be halved. Separations where PVC conduit is utilized for AV systems and/or other adjacent systems must be doubled. Flex conduit is not allowed without written authorization for each separate instance. The Contractor must request information on separation adjustments for each instance where a different type of conduit than what is listed above is used.

3.4 ELECTRICAL POWER

- A. Review and coordinate electrical power system installation including grounding with the electrical contractor to ensure proper operation of the Systems.
- B. Verify that all AC power circuits designated for Systems equipment are wired with correct polarity and isolated ground. Report in writing any discrepancies found to the Architect for corrective action.
- C. Provide distribution of electrical power within the equipment racks with a minimum of one spare AC receptacle for each four in use per branch circuit.
- D. All AV systems electrical power distribution and outlets are provided and installed per the Division of Responsibility Table (see 1.11)
- E. DIV. 26 contractor is to provide engraved cover plates for all power receptacles used in the Audio Video Systems, both isolated ground, and standard circuits that

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are shown as provided by Electrical Contractor. The engraving must call out the panel number and the circuit number(s) for the circuit(s) connected to that particular receptacle. Refer to

3.5 STEEL SUPPORTS

- A. Fabricate and install any supports so that the installation does not weaken or overload the building structure. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems. No drilling or cutting of concrete beams, joists, or structural steel, nor welding to structural steel, will be permitted except as authorized, in writing, by the Architect.

3.6 BOXES

- A. With the exception of portable equipment, all boxes, conduits, cabinets, equipment and related wiring shall be held in place and the mounting shall be plumb and square.
- B. All boxes shall be securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.
- C. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes are not permitted except as authorized, in writing, by the Systems Designer.
- D. Clean all box interiors before installing plates, panels or covers.
- E. Using permanent marker on the box or on wire tags, indicate the lengths of installed cable for all COAX and Category wiring inside the box.
- F. Using permanent marker, inside the box, indicate the box name, for example "STGA".

3.7 WIRING METHODS AND PRACTICES

- A. Provide installation of all Systems wire and cable, ensuring proper:
 - 1. Pulling Tensions
 - 2. Quantities
 - 3. Types
 - 4. Lengths
 - 5. Routing
 - 6. Wire Group Separation
 - 7. Identification
- B. The interconnection of equipment in a rack shall use the same wire by type as specified for runs external to racks unless otherwise indicated on AV single line drawings. All wiring within racks shall be direct between devices without splices.
- C. Interconnection wire between amplifiers and loudspeaker transition panels will be type SP12 (refer to wire types on AV001)
- D. Connector polarity shall be maintained except for terminations at equipment manufactured to other standards. In the event that manufactured equipment can

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be ordered with, or internally set to, various standards, the equipment shall be configured as follows:

1. Polarity for XLR style connector shall be: pin 2-high, pin 3-low, and pin 1-shield.
 2. Polarity for TRS style connector shall be: tip-high, ring-low, and sleeve-shield.
- E. Spare wire runs of each group and type shall be pulled to each termination location. The number of spares shall be ten percent of those in actual use or one, whichever is greater.
- F. Splicing of cables is not permitted between terminations of specified equipment.
- G. Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs without written approval from the Systems Designer; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, and rollers to protect cables from excess tension, abrasion or damaging bending during installation.
- H. Provide wire pulling lubricants and pulling tensions in accordance with the wire and cable manufacturer's recommendations.
- I. All wires shall be permanently identified at each wire end by marking with self-laminating adhesive labels fully covered with clear heat shrink tubing, and a chart kept of each wire's function. This applies to wire within a rack assembly as well as wire running in conduit.
- J. Wire ends should be wrapped with heat shrink tubing. Each shield or drain wire should be covered with heat shrink to avoid unintentional connections.
- K. Use Wago or Entrelec DIN rail mounted terminal blocks for all terminal block wiring connections. Do not exceed one wire per terminal connection point. Do not cut strands from conductors to fit lugs or terminals. Spare terminal blocks, equivalent to 10% of those in actual use, shall be provided.
- L. Form, in an orderly manner, all conductors in enclosures and boxes, wire ways and wiring troughs, providing circuit and conductor identification. Tie using wraps of appropriate size and type. Limit spacing between ties to six (6) inches and provide circuit and conductor identification at least once in each enclosure.
- M. Provide service loops, minimum 6', at each termination so that plates, panels, patch bays, and equipment can be dismantled and placed on an adjacent horizontal work surface allowing for safe service and inspection without disconnection.
- N. Maximum installed length of Category cables is 200'
- O. Maximum installed length of Coaxial cable for HD-SDI, 3G-SDI, 6G-SDI, and 12G-SDI is 200'

3.8 GROUNDING

- A. Audio system wiring shall conform to the following procedures:
1. Audio equipment AC ground pins shall connect to AC isolated ground.
 2. Audio equipment chassis shall connect to AC isolated ground or rack frames.

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3. Audio rack frames shall connect to AC isolated ground bus in panelboard by means of #2 gauge (minimum) conductor.
 4. Audio shields between AC powered pieces of equipment, where signal shield is tied to chassis ground, shall be directly connected to ground at the initiating end only. Capacitively terminate the receiving end with a 0.1 μ F capacitor.
 5. Audio signal paths between AC powered pieces of equipment shall be connected using balanced lines and/or transformer isolation as required. No unbalanced signal paths may be connected to the patch bay.
 6. Isolate all Systems wiring from racks, back boxes and conduit.
 7. Isolate all Systems racks from conduit and other conductive surfaces. Use insulated bushings for conduit connections and a dielectric plinth between racks and conductive flooring materials.
 8. AC isolated ground system shall be isolated from all other facility grounds except at the single point of connection at the AV isolation Transformer.
 9. All metallic conduit, boxes and enclosures shall be grounded in accordance with the current National Electrical Code.
- B. Metallic enclosures containing active equipment shall be grounded with due regard for the minimization of electrical noise. This may include the provision of grounding conductors separate from the AC ground.

3.9 EQUIPMENT RACKS

- A. The equipment racks shall be considered as custom assemblies and shall be assembled, wired and tested in the systems contractor's shop. Assembly of racks on-site will not be permitted, without written approval from the Systems Designer (except for system wiring which must terminate directly to the patch bays via soldering, punch-down or other non-connectorized termination process).
- B. Placement of equipment in equipment racks, as shown in the drawings, is for maximum operator convenience. Verify any changes in placement of the equipment with the Systems Designer before assembly.
- C. Racks shall be installed plumb and square without twists in the frames or variations in level between adjacent racks.
- D. All wire, cable, terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled as to their function, circuit, or system. Labeling on manufactured equipment shall be by engraved plastic laminate or by thermal printer on adhesive tape, with white lettering on black background or dark background that is similar to panel finish.
- E. Provide stiffeners to custom panels to prevent panel deformation during normal plugging or switching operations.
- F. All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses which are tied and supported in accordance with accepted engineering practice.
- G. Harnessed cables shall be combed straight, wrapped every six (6) to ten (10) inches, and attached to the structure as necessary. Each cable that breaks out from a harness for termination shall be provided with an ample service loop so that panels, patch bays, and equipment can be dismantled and placed on an adjacent

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horizontal work surface allowing for safe service and inspection without disconnecting.

- H. Harnessed cables shall be formed in either a vertical or a horizontal relationship to equipment, controls, components or terminations.
- I. All system components and related wiring shall be located with due regard for the minimization of induced electro-magnetic and electrostatic noise, for the minimization of wiring length, for proper ventilation, and to provide reasonable safety and convenience for the operator.
- J. All rack mounted equipment, with front panel controls, shall be provided with security covers to avoid tampering with preset levels. If specific security covers are not included in the equipment list, the systems contractor will provide the manufacturer's security cover for each specified device or a suitable alternate.
- K. Every device shall be installed with regard for proper polarity. Absolute polarity shall be maintained through the entire Systems signal chain.
- L. Any permanently mounted electronic device must be balanced. Systems contractor will provide balancing transformers for unbalanced equipment connections where necessary.

3.10 SYSTEMS CONTRACTOR TESTS

- A. The Systems Contractor must test all the systems and systems components, as described below, prior to Systems Designer Testing and Commissioning. At the conclusion of the Systems Contractor Testing, the Systems Contractor will submit a Written Statement of Completion and test reports indicating test results, including failed tests and re-tests to clear the failures.
- B. Test each point to point wire segment individually, and test any linkage of multiple point to point cables that form an end to end link.
- C. Systems contractor must document all test requirements and results for submission (see 3.12 below).
- D. Confirm that each individual wire and cable run (whether in a rack or in conduit) is identified with a unique number. These numbers are affixed to both ends of each cable and are clearly visible. Provide a complete list of these numbers along with the termination location of each end of the wire run.
- E. Verify all circuits and extensions for correct connection, continuity and polarity. Absolute polarity must be maintained between all points in the system.
- F. Identify installed length of all copper and fiber cabling.
- G. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. A wide band oscilloscope shall be used to verify this condition.
- H. Confirm that the system is free of audible clicks, pops, and other noises when any operating control is activated, with or without input signal.
- I. For MIC, LINE, ACOM, SP48(signal pair), CTRL, AND MIDI cable types, confirm:
 - 1. Proper circuits appearing at each termination location
 - 2. Proper circuits appearing at each jack bay position

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3. Continuity of all conductors
 4. Proper polarity is maintained
 5. Absence of shorts between conductors within each circuit
 6. Absence of shorts between circuit conductors and conduit
 7. Perform a sweep test to 0.5MHz
- J. For ANTS, and ANTL cabling confirm:
1. Verify that TDR impedance is 50 +/-3 ohms
 2. Frequency sweep test from 5MHz to 1000MHz.
- K. For VIDSDI cabling confirm:
1. Verify that the installed cable meets, at a minimum, the requirements set forth in SMPTE ST 2081 for 6G-SDI single-link and 12G-SDI dual-link.
 2. Verify that TDR impedance is 75 +/-3 ohms
 3. Frequency sweep test from 5MHz to 6GHz.
- L. For STP and UTP cabling:
1. Use Category 6A cable pair tester to verify compliance with TIA/EIA standards referenced above (including all current addendums)
 2. Test each cable using the permanent link procedure for opens, shorts, reversals, cross twists and mis-wiring. Check NEXT, ELFEXT, Delay Skew, Return Loss, and Alien Crosstalk.
 3. Report all mis-wiring or failures found and report retests as needed.
 4. If any conductors report open or short, replace the entire wire and re-test.
- M. For OS2 and OM4 Fiber cabling:
1. Using appropriate test devices and proper factory terminated jumpers, measure all fiber optic line attenuations, end to end, as required by TIA/EIA-526-14A.
 2. Optical budget may not exceed the cable performance by length plus splice and connector losses (0.03 dB for each fusion splice, 0.3dB for each mechanical splice, and/or 0.4 dB for each connector).
 3. Overall attenuation must meet TIA/EIA-568B standards. Perform attenuation tests at 850nm and 1300nm as appropriate.
- N. Confirm that loudspeakers and mountings are free of buzzes and rattles when the loudspeaker is swept with sine wave tones over its rated bandwidth at one-half (1/2) its maximum rated power.
- O. For all permanently mounted loudspeaker terminations, provide impedance measurement of each pair of loudspeaker lines with all loudspeakers connected and all amplifiers disconnected. These measurements shall be documented as editable tabular data listing impedance for each 1/3 octave band from 20 Hz to 20 kHz and shall be accurate to the nearest tenth of an Ohm.
- P. For all intercom terminations, confirm proper operation by initiating and receiving audio communication and call light. For single lines connected to a matrix, test each line with each channel in the matrix. Verify that all channels are quiet and without spurious noise.
- Q. For all electronic devices mounted in racks and connected to patch bays, confirm:
1. Every input and output is balanced.
 2. Proper polarity is maintained throughout the entire audio path.

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3. Tip connection of each TRS jack is connected to the positive terminal of each corresponding input or output.
- R. For all devices requiring IP addressing:
1. IP addressing scheme must make use of subnets such that all devices, regardless on which network (Audio, Video, Control, or House) they reside, have a unique IP address to eliminate the possibility of duplicate IP addresses if networks are inadvertently cross-patched.
 2. All devices must have static IP addresses.
 3. Create a spreadsheet of all devices and their IP addresses, Subnet Masks, MAC Addresses, and other pertinent IP configuration information.
 4. Coordinate all IP addressing schemes with the Owner.
- S. If the Audio, Video, and Control network switches are dedicated to these systems and the systems do not rely on Owner furnished and configured network switches:
1. Configure network switches to operate properly and provide the proper network configurations to support the network devices and protocols used by those devices.
 2. Configure, as needed, VLANs, IGMP, QOS, and other protocols requiring configuration to provide a fully functioning and robust network system.
 3. With all networks configured and operating, and all network devices configured and operating, confirm that the networks are behaving as expected and as required.
- T. Electrical Contractor, coordinating with the Systems Contractor must confirm that there are no shorts between the Neutral and Isolated Ground conductors, and between the isolated ground conductor and building ground for each AV Technical Power circuit. Electrical Contractor, coordinating with the Systems Contractor must confirm there are no Bootleg Grounds or Neutral-Ground Reversals on each AV Technical Power circuit.
- U. The systems contractor is responsible for the programming and configuration of all DSP systems and control systems necessary as specified in this project specification and AV large format drawings.
1. Programming and configuration must be complete and ready prior to System Designer's arrival for verification of functionality and acceptance testing.
 2. Programming for the DSP systems must contain control pages to support normal operations, and to support Systems Designer Testing and Commissioning operations, as described in this specification and the large format AV drawings.
 3. Programming for the Control Systems must include all master controller code and touch panel code and graphics, working together to provide the function as described in this specification and the large format AV drawings.
- V. Test all Audio, Video, and Control system controls, including but not limited to mixing consoles, switchers, routers, touch panels, paging stations, volume controls, and source selectors for proper operation.
- W. Test proper operation of any portable controls at each designated control location (Stage Manager's rack, for example).

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3.11 SYSTEMS CONTRACTOR INITIAL SETTINGS

- A. All initial adjustments must be documented and submitted as part of the Systems Contractor Test Reports (see 1.5.C.3.j.ii and 3.12).
- B. Make all adjustments and modifications so that the system is operational and fully functional including but not limited to:
 - 1. Update all device software and firmware to the latest manufacturer's recommended release that allows for proper operation with ALL OTHER DEVICES in the systems.
 - 2. Make all adjustments and modifications for system gain structure per recommendations of major component manufacturers.
 - 3. Properly configure all EDID and HDCP settings to allow for proper function of all video systems.
 - 4. Install all programming for digital mixing consoles, DSP, Control and any other software based devices in the systems, and verify that audio and video signal passes as designed through these systems. Verify that control systems function as specified. Systems contractor to provide initial DSP and control system programming prior to Systems Designer testing, one full set of programming changes and adjustments, prior to handover to the Owner, and one additional set of changes and adjustments during the initial warranty period, as part of the base scope of work.
 - 5. Properly balance all 70 Volt loudspeaker zones to be consistent from zone to zone using amplifier settings and loudspeaker taps to adjust for differing loudspeakers or installation height. All 70 Volt loudspeakers within a given zone must not have a broadband SPL variation of greater than +/- 2dB from center of speaker to center of speaker.
 - 6. Properly adjust delay and equalization for all loudspeaker systems using SIM, SMAART or other similar dual FFT type measurement devices. All testing and adjustment shall be in accordance with all manufacturer recommendations and industry standard practice. Contact the Systems Designer for further system delay and equalization requirements.
 - 7. Capture traces showing magnitude and phase response for each loudspeaker or loudspeaker cluster before and after equalization and delay adjustments.
 - 8. Capture traces showing magnitude and phase response for the systems operating as a whole from 3 locations in each major seating area. One of these areas should be the House Mix Position, if applicable.
 - 9. Equalization and timing of the loudspeaker systems shall be further adjusted as required by the Systems Designer and Owner during Systems Designer Testing and Commissioning.

3.12 SYSTEMS CONTRACTOR TESTING REPORTS

- A. Submit written report detailing the results of Initial Adjustments and Systems Contractor Tests. Report to include, at minimum, the following:
 - 1. Copies of all relevant drawings, charts, test instrument data, and photographs.
 - a. PDF copies of all available manufacturers' operation and service literature for each major system component.

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- b. Copy of all programming files including, but not limited to, Audio DSP programming and Graphic User Interface (GUI) files, Control system Touch Panel GUI files and control system control programming files including un-compiled source codes.
 - c. All other documentation and results of testing and initial settings as referenced in 3.10, and 3.11 above.
 - d. Written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for inspection, Acceptance Testing, and tuning.
2. Prepare and submit an Avixa standard Commissioning Checklist for each system in this specification.
 3. Prepare and submit a training syllabus for Owner training (see section 3.14).
- B. This report shall be completed and submitted to the Systems Designer for review a minimum of five (5) days prior to Systems Designer Testing and Commissioning.

3.13 SYSTEMS DESIGNER TESTING AND COMMISSIONING

- A. Systems Designer Testing and Commissioning shall be performed by the Systems Designer during a period designated by the Architect. Systems contractor shall furnish a minimum of three (3) technicians or one technician per Systems Designer commissioning team, for the acceptance testing period, and one or more engineers fully capable of programming DSP and Control systems, and making any other engineering adjustments to equipment in the systems. Contact Systems Designer for number of commissioning teams that will be deployed. For Bid purposes assume there will be two (2) commissioning teams.
- B. The minimum time required for Systems Designer Testing and Commissioning is two (2) working days, including three (3) blocks of four (4) hour dedicated quiet time. Coordinate this time period so that free access, work lighting, and electrical power are available on the site.
- C. Ensure that Systems areas are in a clean and orderly condition ready for acceptance testing.
- D. Provide test equipment (meeting the following minimum specifications) on site, at all times during Systems Designer Testing and Commissioning. Prior to testing, provide the Systems Designer with a listing of the specific equipment to be made available (#).
1. Oscilloscope: 10MHz Bandwidth, Sensitivity – 1mV/cm
 2. Digital Multi-meter: 1% Accuracy
 3. Function Generator: 1MHz Bandwidth, Distortion < 1%
 4. Real Time Analyzer: 1/3 Octave with microphone
 5. SMAART Analysis package with V.8 software and a minimum of two matching test microphones (Earthworks M30 or better)
 6. Pink Noise Source: 20 Hz – 20 kHz Bandwidth
 7. Test mic tone calibrator
 8. Impedance Sweep Meter: 20 Hz – 20 kHz Range, 1 Ohm – 50 kOhm
 9. Polarity Checker: Mic, line, or loudspeaker level
 10. Video Test Signal Generator(s): must provide all signals, resolutions, and output formats as needed to fully test the systems.

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Systems Designers may choose to supply some of their own test equipment. Confirm specific requirements prior to commissioning

- E. Be prepared to verify the performance of any portion of the system by demonstration, listening tests and instrumented measurements.
- F. Be prepared to facilitate the visual inspection of system components and wiring, including removal of termination panels for inspection of wiring termination and wire management practices.
- G. Be prepared to demonstrate all software and control systems.
- H. Be prepared to go through the commissioning checklist and verify all items as complete.
- I. Make additional mechanical and electrical adjustments within the scope of the work and which are deemed necessary by the Systems Designer as a result of the Acceptance Tests. This may include focusing of loudspeaker systems, changes in system gain structures, grounding, filtering or interfaces.
- J. Systems contractor will bear any costs incurred for additional Systems Designer's time and expenses due to failure to have the system functioning in accordance with specification requirements at the times scheduled for Systems Designer Testing and Commissioning.

3.14 USER TRAINING

- A. Systems contractor will provide in-depth training in operation and regular maintenance of all systems and on all equipment included in the scope of work contained in this specification and the AV large format drawings.
- B. Training to include (but is not limited to):
 - 1. Required Manufacturer provided training.
 - 2. Detailed operation of mixing consoles, video switchers and routers, computer control systems and other essential system elements as relevant to their installation in this project.
 - 3. Maintenance and repair of system equipment, including replacement procedures for user-replaceable parts.
 - 4. Review of Operation and Maintenance Manual (See 3.15)
- C. Systems contractor will provide a minimum of six (6) training sessions of four hours each with times and dates to be approved by the Owner.
- D. The first session shall take place in the presence of the Systems Designer and shall occur directly after the completion of Systems Designer Testing and Commissioning. If the Systems Designer, Owner, and/or Architect judge any work to be deficient and/or not substantially complete at the time scheduled for training, the training will be postponed until the Systems Designer, Owner, and Architect judge the entire AV system conforms to this specification and the AV large format drawings.

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- E. Systems contractor will bear any costs incurred for additional Systems Designer's time and expenses due to failure to have the system functioning in accordance with specification requirements at the times scheduled for User Training.

3.15 SYSTEMS DOCUMENTATION

- A. Systems Designer will review the Systems Documentation submittal (see 1.5.C.3.k) Upon approval of the documentation submittal, the systems contractor will prepare five electronic copies stored on five separate USB storage devices and submit four to the Owner and the fifth to the Systems Designer.

3.16 FINAL ACCEPTANCE

- A. Final acceptance will be contingent upon issuance by the Systems Designer of a letter of acceptance stating that the work has been completed and is in accordance with the contract documents.

APPENDICES TO FOLLOW

APPENDIX A – AUDIO NARRATIVE TULSA PERFORMING ARTS CENTER ARPA 2024 AUDIO NARRATIVE

23 January 2024 – 100% Construction Documents

1. INTRODUCTION

This document is broken down into the following parts:

1. Introduction
2. Facility-Wide
3. Chapman
4. Williams

2. FACILITY-WIDE

2.1 OVERVIEW

The Chapman Theater will receive a new sound system and mixing console system to replace aging equipment. The Williams Theatre will similarly receive a new mixing console system. To achieve this goal, a new fiber optic based networked audio system will be distributed throughout the two theaters to allow for high channel count low latency audio to be transported easily throughout.

We note that there is not an isolated ground power system for AV equipment in the building. As much as possible new electrical work should be installed in anticipation of isolated system in the future.

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This includes running ground wires to each branch circuit, oversized by 2 AWG, and installing hospital grade isolated ground outlets.

2.2 AV EQUIPMENT RACKS

New or repurposed equipment racks will be installed in the Chapman Booth, Chapman Instrument Storage, and Williams Booth. These racks will house Amplifiers, Networking equipment, DSP Digital Signal Processing hardware, and Audio input/output devices.

2.3 AV FIBER NETWORK

A fiber optic network connects all of the mixing consoles and audio input/output racks throughout the facility. In addition an interface is provided to connect the fiber system to Dante and Milan networking equipment in appropriate areas. An auto routing network hub is provided to make connecting and disconnecting fiber loop network elements seamless.

Please note that fiber devices permanently mounted in equipment racks are intended to be connected with LC connectors to reduce cost.

3. CHAPMAN THEATRE

3.1 PERFORMANCE AUDIO SYSTEM

The loudspeaker systems are designed to fulfill the requirements of multiple styles of performance ranging from pop music, to musical theatre, to ballet, to the spoken word. Audio fidelity is paramount to all of these functions and the audio system is designed to provide full range 20hz to 18kHz at every seat with a maximum sustained output level of 105dB +/- 6dB.

- The main system consists of four speaker arrays:
 - i. Main Left and Right arrays that cover the orchestra level of the theater. These arrays are rigged on a winch so that they can be raised up in the catwalks and out of sight when not in use.
 - ii. Main Center array that covers the orchestra level of the theater. This array is permanently hung at center in front of the proscenium.
 1. NOTE: If flying space allows for a larger Main Left and Right Arrays speaker boxes will be moved from the Delay Arrays to the Main Arrays in order to cover the Mezzanine from the Main Arrays. Electronic means will still be provided to turn off the balconies when the are not seated.

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- iii. Finally, a Subwoofer array that provides low frequency extension for the entire auditorium is suspended at center directly behind the Main Center array. It is also permanently hung.
- A set of three delay speaker arrays extend coverage to the balconies.
 - i. Delay Left and Right
 - ii. Delay Center
- Fill speakers are positioned at points in the theatre where architecture makes it impossible for the main and delay loudspeakers to cover a seating area.
 - i. Left and Right fills for when the pit is seated.
 - ii. Stage Lip speakers at the edge of the stage when the pit is seated.
 - iii. Pit Rail speakers at the pit rail when the orchestra pit is in use.
 - iv. 1st Balcony Side Fill consists of two speakers mounted to the wall of the auditorium to cover the extreme side seats on the 1st balcony where the wrap around theater.
 - v. 1st Balcony Delay Side Fill consists of two speakers mounted under the 2nd balcony
 - vi. Orchestra delay speakers extend the fidelity of the main sound system under the balcony with seven delay speakers.

Note that the amplifiers used in the performance audio system are 120V 30A, which may require new or reconfigured electrical circuits.

3.2 SURROUND SPEAKER SYSTEM

The surround speaker systems is provided to compliment the main systems and offer immersive audio opportunities for live performance. Theatrical productions in particular will take advantage of this facility and it opens possibilities for enveloping the audience in any branch of the performing arts.

- The surround speaker consists of speakers on the rear and side walls of the theater at each level of seating.
 - i. Orchestra level
 - 1. Side Walls five speakers each side
 - 2. Rear Wall six speakers
 - 3. Balcony Rail 4 speakers
 - ii. 1st Balcony Level
 - 1. Side Walls three speakers each side
 - 2. Rear Wall six speakers
 - 3. Balcony Front four speakers
 - iii. 2nd Balcony Level
 - 1. Side Walls two speakers
 - 2. Rear Walls six speakers

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- The intent is to use as much of the existing surround speaker wiring as possible. However, a discovery session about the existing wiring runs and cable gauge is necessary before this scope can be adequately settled. It is also intended that this system remain in place and useful after any renovations to the theater so care must be taken to insure the speakers and mounting are removeable or can be protected during construction work.

Please note that this system is not intended to fulfill any cinema surround sound standards.

3.3 DIGITAL MIXING CONSOLE SYSTEM

In order to accommodate a variety of production requirements a large front of console is provided to manage high channel counts with full processing on all channels and an extensive matrix function for addressing the various speaker systems throughout the facility. When this console is not needed, it can be rolled out of the hall and into storage.

A small console is installed in the booth that can handle any simple events, interfacing with guest mixing consoles, and other day to day tasks. If needed, it can also be moved into the FOH mix position.

Connections are also available on stage and either a house console, for instance the main console for the Williams, or a guest console can be patched into the network for monitor duties.

One audio input/output device is permanently placed in the booth to provide analog connections in the booth. Two high channel count i/o devices are mounted in portable rolling racks which can be deployed at A2, on stage or in the pit as needed.

Multicable and stage boxes are provided to efficiently move audio from microphones to the stage boxes.

4. WILLIAMS THEATRE

4.1 DIGITAL AUDIO MIXING CONSOLE SYSTEM

A digital mixing console system is provided for the Williams Theatre. This system is interchangeable with the Chapman system so that crew personnel familiar with either space can easily transfer those skills.

A main console is installed at the FOH mix position in the house. The console is portable and can be removed if required. Since the majority of the productions in this space are musicals, this console is equipped with specialized theatrical

SECTION 27 41 00 – PERFORMANCE AUDIO SYSTEMS

software to leverage the advantages of digital mixing in a musical environment. This software is also available for the Chapman main console and it could be upgraded at any time for a one time fee.

An audio input and output device is provided in the Williams booth to handle all the outputs for productions in the space. A second i/o device provides inputs and outputs on stage. Additionally, a Dante network is leveraged for connection the existing wireless microphone receivers and other peripherals.

Fiber and Cat6A links are available to connect the Williams to the Chapman if ever required but it is anticipated that two spaces will normally be completely independent.

APPENDIX B – MAJOR EQUIPMENT LIST

The following speaker equipment list is based on L-Acoustics Systems. The L-Acoustics Products shown are for REFERENCE ONLY. Please ONLY bid on L-Acoustics Quote Number 0006370SQ-2.

As an alternative, a d&b based system is also available for bidding which has been designed to the same specifications under d&b Sales Quote No.: SQ00044014.

Any questions about the equality of the two designs must be addressed immediately to the consultant.

NOTE: Confirm all colors with architect before ordering.

CHAPMAN SPEAKER SYSTEM

Qty	Manufacturer	Item	Description
<i>Main L/R</i>			
2	L-Acoustics	K3i-Bump	K3i Array Bumper
2	L-Acoustics	K3i-Bar	K3i Array Bumper Extension Bar
16	L-Acoustics	K3i	Line Array Speaker Bi-Amp Dual 12" Install Version
<i>Center Cluster</i>			
6	L-Acoustics	A10i Focus	Arraying Point Source Speaker 10"
1	L-Acoustics	A10i-BUMP	A10i Bumper
<i>Subwoofer</i>			
1	L-Acoustics	KS28-BUMP	KS28 Array Bumper
4	L-Acoustics	KS28	Subwoofer Dual 18" Direct Radiating
<i>Delay Main L/R</i>			
2	L-Acoustics	K3i-Bump	K3i Array Bumper
2	L-Acoustics	K3i-Bar	K3i Array Bumper Extension Bar
12	L-Acoustics	K3i	Line Array Speaker Bi-Amp Dual 12" Install Version

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Delay Center Cluster

5	L-Acoustics	A10i Focus	Arraying Point Source Speaker 10"
1	L-Acoustics	A10i-BUMP	A10i Bumper

Underbalcony

7	L-Acoustics	X8	Arraying Point Source Speaker
7	L-Acoustics	X-UL8i	X8 Long U-Bracket install version

Delays

2	L-Acoustics	X15 HIQ	15" Wedge Coaxial Speaker
2	L-Acoustics	X-UTILT	U Bracket Wall Mount with Tilt
2	L-Acoustics	X-UL15	X15 Long U Bracket

Delay Fill - Mezzanine

2	L-Acoustics	X8	Arraying Point Source Speaker
2	L-Acoustics	X-UL8i	X8 Long U-Bracket install version

Pit Rail

9	L-Acoustics	X4i	4" coaxial point source speaker
9	L-Acoustics	X4i-onCW	X4i Wall or Ceiling mount

Stage Lip

6	L-Acoustics	X8	Arraying Point Source Speaker
6	L-Acoustics	X-UL8i	X8 Long U-Bracket install version

Balcony Rail Surround

4	L-Acoustics	A10i Wide	Arraying Point Source Speaker 30"
4	L-Acoustics	A-U10i	A10i U Bracket

Rear Surrounds

18	L-Acoustics	X8	Arraying Point Source Speaker
18	L-Acoustics	X-UL8i	X8 Long U-Bracket install version

Side Surrounds

20	L-Acoustics	X8	Arraying Point Source Speaker
20	L-Acoustics	X-UL8i	X8 Long U-Bracket install version

Amplifiers

9	L-Acoustics	LA7.16i	16 Channel Amplifier
1	L-Acoustics	LA12X	Amplifier Controller 4 Channel High Power

Items below in the Speaker Cable and Racks sections are NOT included in L-Acoustics or d&b Quote and must be costed separately.

Speaker Multicore Cable for Main L/R Arrays - **coordinate with cable reel provided by rigging contractor**

2	LINK	Mult Cable	LK 48/6 Cable with 32 12AWG conductors - 50'
2	LINK	Fan Out	LK 48/6 to 8 NL4 Connectors 12AWG

Racks

2	Middle Atlantic	ERK-4425-AV	44RU Rack Preconfigured for Pro AV
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MIXING CONSOLES

Qty	Manufacturer	Item	Description
<i>Chapman Console</i>			
1	Digico	Quantum338	Mixing surface with MAD1 and MM OpticalCon
1	Digico	Quantum338 Flight Case	3 piece flight case with pull out drawer
<i>Williams Console</i>			
1	Digico	SD12-96 MAD1 and 1 MM HMA	Mixing surface with MAD1 and MM OpticalCon

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1	Digico	SD12 Theatre Software	T software
1	Digico	SD12 Flight Case	3 piece flight case with pull out drawer
1	Digico	DMI DANTE2 64 Channel @96	64 channel Dante Card at 96 or 48kHz
<i>Chapman Booth</i>			
1	Digico	SD Rack	Empty Rack with MAD1 & MM OpticalCon
2	Digico	SD 32bit Analog Input Card	8 inputs
2	Digico	SD 32bit Output Card	8 Outputs
1	Digico	SD11i	Mixing surface with MAD1 and MM OpticalCon
2	Digico	Orange Box DMI Converter	Empty Box with 2 DMI Slots
2	Digico	DMI Neutrik OpticalCon MM	Multi Mode Optocore on OpticalCon
1	Digico	DMI DANTE2 64 Channel @96	64 channel Dante Card at 96 or 48kHz
1	Digico	DMI Milan Card	AVB Milan Card
<i>Chapman Stage Racks</i>			
2	Digico	SD Rack	Empty Rack with MAD1 & MM OpticalCon
11	Digico	SD 32bit Analog Input Card	8 inputs
5	Digico	SD 32bit Output Card	8 Outputs
<i>Williams Booth</i>			
1	Digico	SD Rack	Empty Rack with MAD1 & MM OpticalCon
2	Digico	SD 32bit Analog Input Card	8 inputs
1	Digico	SD 32bit Output Card	8 Outputs
2	Digico	SD AES i/o Card	8x8
<i>Williams Stage Rack</i>			
1	Digico	SD Rack	Empty Rack with MAD1 & MM OpticalCon
6	Digico	SD 32bit Analog Input Card	8 inputs
3	Digico	SD 32bit Output Card	8 Outputs
Multicable			
2	Link	Multi Cable	20ch Cable with LK 85 Connector M to F - 15'
4	Link	Multi Cable	20ch Cable with LK 85 Connector M to F - 25'
4	Link	Multi Cable	20ch Cable with LK 85 Connector M to F - 50'
5	Link	Stage Box	Stage Box 16 Female XLR 4 Male XLR, LK 85 Male
5	Link	Fan Tails	Fan out 16 Male XLR, 4 Female XLR, LK 85 Female
Cable			
CONFIRM COLOR CODING BEFORE ORDERING			
8	Whirlwind	ENC6ASE06	6' Cat6A Cable
4	Whirlwind	ENC6ASE10	10' Cat6A Cable
4	Whirlwind	ENC6ASE25	25' Cat6A Cable
4	Whirlwind	ENC6ASE50	50' Cat6A Cable
2	Custom	TBD	HMA to OpticalCon Adapters
10	Neutrik	NKO2M-L-0-3	OpticalCon Duo Lite MM Tactical Cable 3 meter ~10'
10	Neutrik	NKO2M-L-0-10	OpticalCon Duo Lite MM Tactical Cable 10 meter ~32'
4	Neutrik	NKO2M-L-0-25	OpticalCon Duo Lite MM Tactical Cable 25 meter ~82'
Patchbay			
4	Black Box	JPM385A	24 port LC Duplex Patch Panel - Feed Through, 1RU
4	Black Box	JPMT700A	24 port CAT6A Patch Panel - feed through, 1RU
1	TBD	TBD	LC Duplex Patch Cable as needed plus 10%
1	TBD	TBD	Cat6A Patch Cable as needed plus 10%
Networking			
6	Netgear	GSM4248P	Network Switch 40 port with POE+ and 4 SFP+
4	Netgear	GSM4230PX	Network Switch 24 port with SFP and POE+

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2	Ubiquiti	Dream Machine Pro	Network Router
4	Ubiquiti	UniFi U6 Long-Range	WiFi Access Point
2	Optocore	Autorouter R66AR10MM	Optical Autorouter MM 10 location, 20 SFP
12	Netgear	AXM761	SFP+ Multi Mode 10Gig Fiber Transceiver
2	Apple	iPad	Tablet Computer
Racks			
	Middle		
2	Atlantic	ERK-4425-AV	44RU Rack Preconfigured for Pro AV
3	ProX	T-16RSS	16RU Rolling Flight Case Rack 19" deep

END OF SECTION 27 41 00

SECTION 28 31 11 - DIGITAL ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes electrical requirements and provisions for fire alarm systems.

1.2 DEFINITIONS

- A. EMI: Electromagnetic interference.

1.3 SUBMITTALS

- A. Product Data: Include data on features, ratings, and performance for each component specified.
- B. Shop Drawings: Include dimensioned plan and elevation views of each individual component. Show equipment assemblies, method of field assembly, workspace requirements, and access for cable connections.
 - 1. Conduit riser diagram including all Fire Alarm Conduits.
 - 2. Routing of all conduit following the spacing requirements on the drawings.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate all work with Fire Alarm Contractor, Owner or Owner's Representative and Architect.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

2.2 MOUNTING ELEMENTS

- A. Raceways and Boxes: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems."

2.3 FIRE ALARM DEVICE OUTLETS

- A. Wall-mounted Fire Alarm Pull Station Outlet: +46" A.F.F. U.O.N. Provide 4" square extra deep box with single gang raised cover (mud ring) and 3/4" conduit stubbed into accessible ceiling space. Provide a pull string in conduit and single-gang junction box at end of conduit. Provide one dedicated conduit per outlet. In rooms/areas with gypboard ceiling or unaccessible ceiling provide a 4" square extra deep box with single gang raised cover (mud ring) and 3/4" continuous conduit routed to the nearest accessible ceiling. Provide a pull string in conduit and single-gang junction box at end of conduit.
- B. Wall-mounted Strobe Light Outlet: +80" A.F.F. U.O.N. Provide 4" square extra deep box with single gang raised cover (mud ring) and 3/4" conduit stubbed into accessible ceiling space. Provide a pull string in conduit and single-gang junction box at end of conduit. Provide one dedicated conduit per outlet. In rooms/areas with gypboard ceiling or unaccessible ceiling provide a 4" square extra deep box with single gang raised cover (mud ring) and 3/4" continuous conduit routed to the nearest accessible ceiling. Provide a pull string in conduit and single-gang junction box at end of conduit.
- C. Wall-mounted Speaker Outlet: +80" A.F.F. U.O.N. Provide 4" square 1 1/2" deep box with 1 1/2" extension ring and 3/4" conduit stubbed into accessible ceiling space. Provide a pull string in conduit and single-gang junction box at end of conduit. Provide one dedicated conduit per outlet. In rooms/areas with gypboard ceiling or unaccessible ceiling provide a 4" square 1 1/2" deep box with 1 1/2" extension ring and 3/4" continuous conduit routed to the nearest accessible ceiling. Provide a pull string in conduit and single-gang junction box at end of conduit.
- D. Wall-mounted Combination Strobe Light/Speaker Outlet: +80" A.F.F. U.O.N. Provide 4" square 1 1/2" deep box with 1 1/2" extension ring and 3/4" conduit stubbed into accessible ceiling space. Provide a pull string in conduit and single-gang junction box at end of conduit. Provide one dedicated conduit per outlet. In rooms/areas with gypboard ceiling or unaccessible ceiling provide a 4" square 1 1/2" deep box with 1 1/2" extension ring and 3/4" continuous conduit routed to the nearest accessible ceiling. Provide a pull string in conduit and single-gang junction box at end of conduit.
- E. Ceiling-mounted Strobe Light Outlet: In gypboard ceilings, provide 4" square extra deep box with single gang raised cover and 3/4" continuous conduit routed to the nearest accessible ceiling. Provide a pull string in conduit and single-gang junction box at end of conduit. In lay-in ceilings, provide caddy bar support, Erico model #512 or Engineer approved equal and 4" square extra deep box with single gang raised cover.
- F. Ceiling-mounted Combination Strobe Light/Speaker Outlet: In gypboard ceilings, provide 4" square 1 1/2" deep box with 1 1/2" extension ring and 3/4" continuous conduit routed to the nearest accessible ceiling. Provide a pull string in conduit and single-gang junction box at end of conduit. In lay-in ceilings, provide caddy bar support, Erico model #512HD or Engineer approved equal and 4" square 1 1/2" deep box with 1 1/2" extension ring.
- G. Ceiling-mounted Smoke Detector: In gypboard ceilings, provide 4" square extra deep box with round ring and 3/4" continuous conduit routed to the nearest accessible ceiling. Provide a pull string in conduit and single-gang junction box at end of conduit. In lay-in ceilings, provide caddy bar support, Erico model #512 or Engineer approved equal and 4" square extra deep box with round ring.
- H. Ceiling-mounted Heat Detector: In gypboard ceilings, provide 4" square extra deep box with round ring and 3/4" continuous conduit routed to the nearest accessible ceiling. Provide a pull string in conduit and single-gang junction box at end of conduit. In lay-in ceilings, provide caddy bar support, Erico model #512 or Engineer approved equal and 4" square extra deep box with round ring.

- I. Duct-mounted Smoke Detector: Provide mounting components/modules in accordance with fire alarm manufacturer recommendations and ductwork, coordinate with Fire Alarm Contractor and Mechanical.
- J. Monitoring Module Outlet: Provide 4" square extra deep box with single gang raised cover.
- K. Remote Annunciator: Provide standard pre-fabricated 6-gang outlet box from fire alarm manufacturer, coordinate with Fire Alarm Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Raceways/Conduits for Fire Alarm Wiring Method: Provide raceways for all fire alarm wiring.
- B. Refer to Division 28 Section "Addressable Fire Alarm Systems" for other raceway/conduit requirements.
- C. Provide one spare conduit with pull string of equal or greater size for every six conduits routed from fire alarm control panel or fire alarm power supply to common area for future. Label conduit as "Spare Fire Alarm" and provide red painted band at each end and every 40'-0" intervals.
- D. Install all conduits parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible. Conduits shall be mounted as high as possible in open structure areas to minimize visibility. Coordinate exact requirements with Architect.
- E. Install all fire alarm conduit risers with wall or floor penetrations in accordance with the National Electrical Code (NEC) Article 760.52. Coordinate all riser requirements and locations with Fire Alarm Contractor. Seal all penetrations accordingly.
- F. Separation of Wire Pathways: Follow manufacturer recommendations for separating unshielded cabling from potential EMI sources, including electrical power lines and equipment, coordinate with Fire Alarm Contractor.

3.3 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

END OF SECTION