

PROJECT MANUAL

March 15, 2022

**HVAC UPGRADES
AT
ROGER WILLIAMS PARK
NATURAL HISTORY MUSEUM
-REBID-
FOR THE
CITY OF PROVIDENCE
RHODE ISLAND**

**SACCOCCIO & ASSOCIATES
ARCHITECTS**



1085 PARK AVENUE
CRANSTON, RHODE ISLAND

PROJECT NUMBER 21041

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**BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND**

REQUEST FOR PROPOSALS

Item Description: HVAC UPGRADES TO THE ROGER WILLIAMS PARK MUSEUM OF NATURAL HISTORY AND PLANETARIUM -REBID-

Date to be opened: APRIL 25, 2022

Issuing Department: PARKS DEPARTMENT

QUESTIONS

- Please direct questions relative to the bidding process, how to fill out forms, and how to submit a bid (Pages 1-8) to Purchasing Agent Patti Jordan.
 - Phone: (401) 680-5264
 - Email: pjordan@providenceri.gov
 - Please use the subject line “**RFP Question**”
- Please direct questions relative to the Minority and Women’s Business Enterprise Program and the corresponding forms (Pages 9-13) to the MBE/WBE Outreach Director for the City of Providence, Grace Diaz
 - Phone: (401) 680-5766
 - Email: gdiaz@providenceri.gov
 - Please use subject line “**MBE WBE Forms**”
- Please direct questions relative to the specifications outlined (beginning on page 14) to the issuing department’s subject matter expert:
 - **Brian F. Byrnes**
 - **401-660-9308**
 - Bbyrnes@providenceri.gov

Pre-bid Conference - Walkthrough (Mandatory)

Tuesday, April 5, 2022, at 11:00 AM

Roger Williams Park Museum of Natural History and Planetarium, 1000 Elmwood Ave., Providence, RI 02905

Second Pre-bid Conference - Walkthrough (NON-Mandatory)

Tuesday, April 12, 2022, at 11:00 AM

Roger Williams Park Museum of Natural History and Planetarium 1000 Elmwood Ave., Providence, RI 02905



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

INSTRUCTIONS FOR SUBMISSION

Bids may be submitted up to **2:15 P.M.** on the above meeting date at the **Department of the City Clerk, Room 311, City Hall, 25 Dorrance Street, Providence.** At 2:15 P.M. all bids will be publicly opened and read at the Board of Contract Meeting in the City Council Chambers, on the 3rd floor of City Hall.

- Bidders must submit **2 copies** of their bid in sealed envelopes or packages labeled with the caption “Bid for HVAC Upgrades to the Roger Williams Park Natural History Museum” and the **City Department to which the RFP and bid are related.** (On page 1)
- Communications to the Board of Contract and Supply that are not competitive sealed bids (i.e. product information/samples) should have “**NOT A BID**” written on the envelope or wrapper.
- Only use form versions and templates included in this RFP. If you have an old version of a form do not recycle it for use in this bid.
- The bid envelope and information relative to the bid must be addressed to:

**Board of Contract and Supply
Department of the City Clerk – City Hall, Room 311
25 Dorrance Street
Providence, RI 02903**

****PLEASE NOTE:** This bid may include details regarding information that you will need to provide (such as proof of licenses) to the issuing department before the formalization of an award.

This information is NOT requested to be provided in your initial bid by design.

All bids submitted to the City Clerk become public record. Failure to follow instructions could result in information considered private being posted to the city’s Open Meetings Portal and made available as a public record. The City has made a conscious effort to avoid the posting of sensitive information on the City’s Open Meetings Portal, by requesting that such sensitive information be submitted to the issuing department only at their request.



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID PACKAGE CHECKLIST

Digital forms are available in the City of Providence Purchasing Department Office or online at <http://www.providenceri.gov/purchasing/how-to-submit-a-bid/>

The bid package **MUST** include the following, in this order:

- Bid Form 1: Bidder's Blank as the cover page/ 1st page (*see page 6 of this document*)
- Bid Form 2: Certification of Bidder as 2nd page (*see page 7 of this document*)
- Bid Form 3: Certificate Regarding Public Records (*see page 8 of this document*)
- Forms from the Minority and Women Business Enterprise Program: Based on Bidder Category. See forms and instructions enclosed (pages 9-13) or on: <https://www.providenceri.gov/purchasing/minority-women-owned-business-mbewbe-procurement-program/>

***Please note: MBE/WBE forms must be completed for EVERY bid submitted and must be inclusive of ALL required signatures. Forms without all required signatures will be considered incomplete.**

- Bidder's Proposal/Packet: Formal response to the specifications outlined in this RFP, including pricing information and details related to the good(s) or service(s) being provided. Please be mindful of formatting responses as requested to ensure clarity.
- Financial Assurance, *if requested* (as indicated on page 5 of this document under "Bid Terms")

All of the above listed documents are REQUIRED. (With the exception of financial assurances, which are only required if specified on page 5.)

*****Failure to meet specified deadlines, follow specific submission instructions, or enclose all required documents with all applicable signatures will result in disqualification, or in an inability to appropriately evaluate bids.**



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

NOTICE TO VENDORS

1. The Board of Contract and Supply will make the award to the lowest qualified and responsible bidder.
2. In determining the lowest responsible bidder, cash discounts based on preferable payment terms will not be considered.
3. Where prices are the same, the Board of Contract and Supply reserves the right to award to one bidder, or to split the award.
4. No proposal will be accepted if the bid is made in collusion with any other bidder.
5. Bids may be submitted on an "equal in quality" basis. The City reserves the right to decide equality. Bidders must indicate brand or the make being offered and submit detailed specifications if other than brand requested.
6. A bidder who is an out-of-state corporation shall qualify or register to transact business in this State, in accordance with the Rhode Island Business Corporation Act, RIGL Sec. 7-1.2-1401, et seq.
7. The Board of Contract and Supply reserves the right to reject any and all bids.
8. Competing bids may be viewed in person at the Department of the City Clerk, City Hall, Providence, immediately upon the conclusion of the formal Board of Contract and Supply meeting during which the bids were unsealed/opened. Bids may also be accessed electronically on the internet via the City's [Open Meetings Portal](#).
9. As the City of Providence is exempt from the payment of Federal Excise Taxes and Rhode Island Sales Tax, prices quoted are not to include these taxes.
10. In case of error in the extension of prices quoted, the unit price will govern.
11. The contractor will **NOT** be permitted to: a) assign or underlet the contract, or b) assign either legally or equitably any monies or any claim thereto without the previous written consent of the City Purchasing Director.
12. Delivery dates must be shown in the bid. If no delivery date is specified, it will be assumed that an immediate delivery from stock will be made.
13. A certificate of insurance will normally be required of a successful vendor.
14. For many contracts involving construction, alteration and/or repair work, State law provisions concerning payment of prevailing wage rates apply ([RIGL Sec. 37-13-1 et seq.](#))
15. No goods should be delivered or work started without a Purchase Order.
16. **Submit 2 copies of the bid to the City Clerk, unless the specification section of this document indicates otherwise.**
17. Bidder must certify that it does not unlawfully discriminate on the basis of race, color, national origin, gender, gender identity or expression, sexual orientation and/or religion in its business and hiring practices and that all of its employees are lawfully employed under all applicable federal, state and local laws, rules and regulations. (See Bid Form 2.)



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID TERMS

1. Financial assurances may be required in order to be a successful bidder for Commodity or Construction and Service contracts. If either of the first two checkboxes below is checked, the specified assurance must accompany a bid, or the bid will not be considered by the Board of Contract and Supply. The third checkbox indicates the lowest responsible bidder will be contacted and required to post a bond to be awarded the contract.
 - a) ☐ A certified check for \$_____ must be deposited with the City Clerk as a guarantee that the Contract will be signed and delivered by the bidder.
 - b) ☒ A bid bond in the amount of **5%** per centum (%) of the proposed total price, must be deposited with the City Clerk as a guarantee that the contract will be signed and delivered by the bidder; and the amount of such bid bond shall be retained for the use of the City as liquidated damages in case of default.
 - c) ☒ A performance and payment bond with a satisfactory surety company will be posted by the bidder in a sum equal to one hundred per centum (100%) of the awarded contract.
 - d) ☐ No financial assurance is necessary for this item.
2. Awards will be made within **sixty (60) days of bid opening**. All bid prices will be considered firm, unless qualified otherwise. Requests for price increases will not be honored.
3. Failure to deliver within the time quoted or failure to meet specifications may result in default in accordance with the general specifications. It is agreed that deliveries and/or completion are subject to strikes, lockouts, accidents and Acts of God.

The following entry applies only for COMMODITY BID TERMS:

4. Payment for partial delivery will not be allowed except when provided for in blanket or term contracts.

The following entries apply only for CONSTRUCTION AND SERVICE BID TERMS:

5. Only one shipping charge will be applied in the event of partial deliveries for blanket or term contracts.
6. Prior to commencing performance under the contract, the successful bidder shall attest to compliance with the provisions of the Rhode Island Worker's Compensation Act, RIGL 28-29-1, et seq. If exempt from compliance, the successful bidder shall submit a sworn Affidavit by a corporate officer to that effect, which shall accompany the signed contract.
7. Prior to commencing performance under the contract, the successful bidder shall, submit a certificate of insurance, in a form and in an amount satisfactory to the City.



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID FORM 1: Bidders Blank

1. Bids must meet the attached specifications. Any exceptions or modifications must be noted and fully explained.
2. Bidder's responses must be in ink or typewritten, and all blanks on the bid form should be completed.
3. The price or prices proposed should be stated both in **WRITING** and in **FIGURES**, and any proposal not so stated may be rejected. **Contracts exceeding twelve months must specify annual costs for each year.**
4. Bids **SHOULD BE TOTALED** so that the final cost is clearly stated (unless submitting a unit price bid), however **each item should be priced individually**. Do not group items. Awards may be made on the basis of *total* bid or by *individual items*.
5. All bids **MUST BE SIGNED IN INK.**

Name of Bidder (Firm or Individual): _____

Contact Name: _____

Business Address: _____

Business Phone #: _____

Contact Email Address: _____

Agrees to bid on (Write the "Item Description" here): _____

If the bidder's company is based in a state other than Rhode Island, list name and contact information for a local agent for service of process that **is located within Rhode Island** _____

Delivery Date (if applicable): _____

Name of Surety Company (if applicable): _____

Total Amount in Writing*: _____

Total Amount in Figures*: _____

Use additional pages if necessary for additional bidding details.

Signature of Representation

Title



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID FORM 2: Certification of Bidder
(Non-Discrimination/Hiring)

Upon behalf of _____ (Firm or Individual Bidding),

I, _____ (Name of Person Making Certification),

being its _____ (Title or "Self"), hereby certify that:

1. Bidder does not unlawfully discriminate on the basis of race, color, national origin, gender, sexual orientation and/or religion in its business and hiring practices.
2. All of Bidder's employees have been hired in compliance with all applicable federal, state and local laws, rules and regulations.

I affirm by signing below that I am duly authorized on behalf of Bidder, on
this _____ day of _____ 20____.

Signature of Representation

Printed Name



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID FORM 3: Certificate Regarding Public Records

Upon behalf of _____ (Firm or Individual Bidding),

I, _____ (Name of Person Making Certification),

being its _____ (Title or "Self"), hereby certify an

understanding that:

1. All bids submitted in response to Requests for Proposals (RFP's) and Requests for Qualification (RFQ's), documents contained within, and the details outlined on those documents become public record upon receipt by the City Clerk's office and opening at the corresponding Board of Contract and Supply (BOCS) meeting.
2. The Purchasing Department and the issuing department for this RFP/RFQ have made a conscious effort to request that sensitive/personal information be submitted directly to the issuing department and only at request if verification of specific details is critical the evaluation of a vendor's bid.
3. The requested supplemental information may be crucial to evaluating bids. Failure to provide such details may result in disqualification, or an inability to appropriately evaluate bids.
4. If sensitive information that has not been requested is enclosed or if a bidder opts to enclose the defined supplemental information prior to the issuing department's request in the bidding packet submitted to the City Clerk, the City of Providence has no obligation to redact those details and bears no liability associated with the information becoming public record.
5. The City of Providence observes a public and transparent bidding process. Information required in the bidding packet may not be submitted directly to the issuing department at the discretion of the bidder in order to protect other information, such as pricing terms, from becoming public. Bidders who make such an attempt will be disqualified.

I affirm by signing below that I am duly authorized on behalf of Bidder, on

this _____ day of _____ 20_____.

Signature of Representation

Printed Name



BOARD OF CONTRACT AND SUPPLY CITY OF PROVIDENCE, RHODE ISLAND

WBE/MBE Form Instructions

The City of Providence actively seeks Minority and Women business enterprises to participate in bids to meet the City's procurement needs. Pursuant to the City of Providence Code of Ordinances, Chapter 21, Article II, Sec. 21-52 (Minority and Women's Business Enterprise) and Rhode Island General Laws (as amended), Chapter 31-14, et seq. (Minority Business Enterprise), Minority Business Enterprise (MBE) and Women's Business Enterprise (WBE) participation goals apply to contracts.

The goal for Minority Business Enterprise (MBE) participation is **10%** of the total bid value.

The goal for Women's Business Enterprise (WBE) participation is **10%** of the total bid value.

The goal for combined MBE/WBE participation is **20%** of the total bid value.

Only businesses certified with the State of Rhode Island as minority and/or women business enterprises are counted towards the City's goals. Eligible minority or women-owned businesses are encouraged to seek certification from the State of Rhode Island Minority Business Enterprise Compliance Office at: <http://odeo.ri.gov/offices/mbeco/>

Note: MBE certification with the State of Rhode Island on the basis of Portuguese heritage is not currently recognized by the City of Providence's MBE program.

Bid Requirements:

All Bidders: All bidders must complete and submit the **MBE/WBE Participation Affidavit** indicating whether or not they are a state-certified MBE/WBE and acknowledging the City's participation goals. Submission of this form is required with **every bid**. Your bid will not be accepted without an affidavit.

Bidders who will be subcontracting: Bidders who will be subcontracting must submit the **Subcontractor Disclosure Form** as part of their bid submission. All subcontractors, regardless of MBE/WBE status, must be listed on this form. Business NAICS codes can be found at <https://www.naics.com/search/>. Awarded bidders are required to submit **Subcontractor Utilization and Payment Reports** with each invoice.

Waiver Requests:

If the percentage of the total amount of the bid being awarded to MBE or WBE vendors is less than 20% (Box F on the Subcontractor Disclosure Form) and the prime contractor is not a Rhode Island State-certified MBE or WBE, the Bidder must complete the **MBE/WBE Waiver Request Form** for review. Waivers will be considered on a case by case basis.

No waiver will be granted unless the waiver request includes documentation that demonstrates that the Bidder has made good faith efforts to achieve the City's stated participation goals. Waivers must be reviewed and signed by the City of Providence's MBE/WBE Outreach Director, Grace Diaz, or her designee. Department Directors cannot recommend a bidder for award if this form is applicable and absent. If the bid does not meet the participation goals of the City of Providence and a waiver is not filed with the signature of the MBE/WBE Outreach Director or her designee, the bid will not be accepted.

Verifying MBE/WBE Certification

It is the responsibility of the bidder to confirm that every MBE/WBE named in a proposal and included in a contract is certified by the Rhode Island Minority Business Enterprise Compliance office. The current MBE/WBE directory is available at the State of RI MBE Office, One Capitol Hill, 2nd Floor, Providence, RI, or online at <http://odeo.ri.gov/offices/mbeco/mbe-wbe.php>. You can also call (401) 574-8670 to verify certification, expiration dates, and services that the MBE/WBE is certified to provide. Note: MBE certification with the State of Rhode Island on the basis of Portuguese heritage is not currently recognized by the City of Providence's MBE program.



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

Form Instructions:

Access all bid forms from <http://www.providenceri.gov/oeo/> or <http://www.providenceri.gov/purchasing/minority-women-owned-business-mbewbe-procurement-program/>. **Download** the forms as blank PDFs. Once saved on your computer, fill them out using the Adobe program. The fillable PDFs must be completed in Adobe in order to be saved properly. Google Chrome and similar platforms do not allow for the forms to be saved as filled PDFs. Therefore, please download the blank forms to your computer, then fill them out and save.

Assistance with Form Requirements

Examples of completed forms can be found on the City of Providence website at <http://www.providenceri.gov/oeo/> or <http://www.providenceri.gov/purchasing/minority-women-owned-business-mbewbe-procurement-program/>.

Contract Requirements:

Prime contractors engaging subcontractors must submit the ***Subcontractor Utilization and Payment Report*** to the City Department's Fiscal Agent with every invoice and with request for final payment. This form is not submitted as a part of the initial bid package.

For contracts with duration of less than 3 months, this form must be submitted along with the contractor's request for final payment. The form must include all subcontractors utilized on the contract, both MBE/WBE and non- MBE/WBE, the total amount paid to each subcontractor for the given period and to date. During the term of the contract, any unjustified failure to comply with the MBE/WBE participation requirements is a material breach of contract.

Questions?

For more information or for assistance with MBE/WBE Forms, contact the City of Providence MBE/WBE Outreach Director, Grace Diaz, at mbw-wbe@providenceri.com or (401) 680-5766.



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

MBE/WBE PARTICIPATION AFFIDAVIT

Item Discussion (as seen on RFP):

Prime Bidder: _____

Prime Bidder (Company) Phone Number: _____

Which one of the following describes your business' status in terms of Minority and/or Woman-Owned Business Enterprise certification with the State of Rhode Island? ☐ MBE ☐ WBE ☐ Neither MBE nor WBE

By initialing the following sections and signing the bottom of this document in my capacity as the contractor or an authorized representative of contractor, I make this Affidavit:

It is the policy of the City of Providence that minority business enterprises (MBEs) and women business enterprises (WBEs) should have the maximum opportunity to participate in procurements and projects as prime contractors and vendors. Pursuant to Sec. 21-52 of the Providence Code of Ordinances and Chapter 31-14 *et seq.* of the Rhode Island General Laws (as amended), MBE and WBE participation goals apply to contracts.

The goal for Minority Business Enterprise (MBE) participation is 10% of the total bid value.

The goal for Women's Business Enterprise (WBE) participation is 10% of the total bid value.

The goal for combined MBE/WBE participation is 20% of the total bid value.

I acknowledge the City of Providence's goals of supporting MBE/WBE certified businesses. Initial _____

If awarded the contract, I understand that my company must submit to the Minority and Women's Business Coordinator at the City of Providence (MBE/WBE Office), copies of all executed agreements with the subcontractor(s) being utilized to achieve the participation goals and other requirements of the RI General Laws. **I understand that these documents must be submitted prior to the issuance of a notice to proceed.** Initial _____

I understand that, if awarded the contract, my firm must submit to the MBE/WBE Office canceled checks and reports required by the MBE/WBE Office on a quarterly basis verifying payments to the subcontractors(s) utilized on the contract.

Initial _____

If I am awarded this contract and find that I am unable to utilize the subcontractor(s) identified in my Statement of Intent, I understand that I must substitute another certified MBE and WBE firm(s) to meet the participation goals. **I understand that I may not make a substitution until I have obtained the written approval of the MBE/WBE Office.**

Initial _____

If awarded this contract, I understand that authorized representatives of the City of Providence may examine the books, records and files of my firm from time to time, to the extent that such material is relevant to a determination of whether my firm is complying with the City's MBE/WBE participation requirements.

Initial _____

I do solemnly declare and affirm under the penalty of perjury that the contents of the foregoing Affidavit are true and correct to the best of my knowledge, information and belief.

Signature of Bidder

Printed Name

Company Name

Date



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

SUBCONTRACTOR DISCLOSURE FORM

Fill out this form only if you WILL SUBCONTRACT with other parties. If you will not subcontract any portion of the proposed bid, do not fill out this form.

Prime Bidder: _____ Primary NAICS _____

Code: _____

Item Description (as seen on RFP): _____

Please list all Subcontractors below. Include the total dollar value that you propose to share with each subcontractor and the dollar amount to be subcontracted. Please check off MBE and WBE where applicable. The directory of all state-certified MBE/WBE firms is located at www.mbe.ri.gov. Business NAICS codes can be found at <https://www.naics.com/search/>

Proposed Subcontractor	MBE	WBE	Primary NAICS Code	Date of Mobilization	\$ Value of Subcontract
					\$
					\$
					\$
					\$
					\$
					\$
A. MBE SUBCONTRACTED AMOUNT:					\$
B. WBE SUBCONTRACTED AMOUNT:					\$
C. NON MBE WBE SUBCONTRACTED AMOUNT:					\$
D. DOLLAR AMOUNT OF WORK DONE BY THE PRIME CONTRACTOR:					\$
E. TOTAL AMOUNT OF BID (SUM OF A, B, C, & D):					\$
F. PERCENTAGE OF BID SUBCONTRACTED TO MBEs AND WBEs. (Divide the sum of A and B by E and multiply result by 100).					%

Please read and initial the following statement acknowledging you understand. If the percentage of the total amount of the bid being awarded to MBE or WBE vendors is less than 20% (Box F) and the prime contractor is NOT a Rhode Island State-certified MBE or WBE, you must fill out the MBE/WBE WAIVER REQUEST FORM for consideration by City of Providence MBE/WBE Outreach Director. Initial _____

Signature of Bidder

Printed Name



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

MBE/WBE Waiver Request Form

Fill out this form only if you are subcontracting and did not meet the 20% MBE/WBE participation goal.
State-certified MBE or WBE Prime Bidders are NOT REQUIRED to fill out this form.

Submit this form to the City of Providence MBE/WBE Outreach Director, Grace Diaz, at mbe-wbe@providenceri.gov, for review **prior to bid submission**. This waiver applies only to the current bid which you are submitting to the City of Providence and does not apply to other bids your company may submit in the future.

Prime Bidder: _____

Company Trade: _____

Item Discussion (as seen on RFP): _____

To receive a waiver, you must list the certified MBE and/or WBE companies you contacted, the name of the primary individual with whom you interacted, and the reason the MBE/WBE company could not participate on this project.

MBE/WBE Company Name	Individual's Name	Company Trade	Why did you choose not to work with this company?

I acknowledge the City of Providence's goal of a combined MBE/WBE participation is 20% of the total bid value. I am requesting a waiver of _____ % MBE/WBE (20% minus the value of **Box F** on the Subcontractor Disclosure Form). If an opportunity is identified to subcontract any task associated with the fulfillment of this contract, a good faith effort will be made to select MBE/WBE certified businesses as partners.

Signature of Prime Contractor

Printed Name

Date Signed

Signature of City of Providence
MBE/WBE Outreach Director

Printed Name of City of Providence
MBE/WBE Outreach Director

Date Signed



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

SUPPLEMENTAL INFORMATION

If the issuing department for this RFP determines that your firm's bid is best suited to accommodate their need, you will be asked to provide proof of the following prior to formalizing an award.

An inability to provide the outlined items at the request of the department may lead to the disqualification of your bid.

*This information is **NOT** requested to be provided in your initial bid that you will submit to the City Clerk's office by the "date to be opened" noted on page 1. This list only serves as a list of items that your firm should be ready to provide on request.*

All bids submitted to the City Clerk become public record. Failure to follow instructions could result in information considered private being posted to the city's Open Meetings Portal and made available as a public record.

Awarded vendor must be able to provide:

- **Business Tax ID**
- **Proof of Insurance**
- **Qualifications and Past Project References**
- **Current Work on Hand**



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID FORM 3: Supplemental Bid Form

To whom it may concern:

1. The undersigned, having familiarized (himself) (themselves) (itself) with the **HVAC UPGRADES TO THE ROGER WILLIAMS PARK MUSEUM OF NATURAL HISTORY AND PLANETARIUM -REBID-** bid affecting the cost of work, and with the Contract Documents (which includes the Invitation for Bids, Instructions to Bidders, Form of Bid Bond, Form of Agreements, form of Non-Collusive Affidavit, Addenda (if any), Drawings, Technical Specification, Form of Surety Bond(s); as prepared by the Providence Parks Department, and on file in the office of the City Clerk 3rd Floor, City Hall, Providence, RI 02903, hereby proposes to furnish all supervision, technical personnel, labor, materials, machinery, tools, equipment and services including utility and transportation services, and to perform such other required work for the **HVAC UPGRADES TO THE ROGER WILLIAMS PARK MUSEUM OF NATURAL HISTORY AND PLANETARIUM -REBID-** and such other required and incidental work, complete, all in accordance with the above listed documents and for the unit prices for work in-place for the following items and quantities.

2. In submitting this Bid, the bidder understands that the right is reserved by The Providence Parks Department to reject any and all Bids, If written notice of acceptance of this Bid is mailed, telegraphed or delivered to the undersigned within (60) days after the opening thereof, or at any time thereafter before this Bid is withdrawn, the undersigned agrees to execute and deliver an Agreement in the prescribed form and furnish the required bond within (10) days after the Agreement is presented to him/her for signature.

Herewith in accordance with the instructions to Bidders.

3. Attached hereto is an affidavit in proof that the undersigned has not colluded with any person in respect to this. Bid or any bids for the Contractor for which this Bid is submitted. Also attached is a Statement of Bidder's Qualifications.

4. application unit prices are contained in the Agreement (established as the result of either a Unit Price Bid or a Supplemental Schedule of Unit Prices), the City of Providence may order the Contractor to proceed with desired changes in the work, the value of such changes to be determined by the measured quantities involved and the application unit prices specified in the Contract.

5. The City of Providence reserves the right to determine the lowest responsible Bidder based on past experience with the City and/or recommendations by City and/or state agencies with an interest in this procurement. The City reserves the right to award the project to the appropriate bidder in the best interest of the City of Providence.



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CERTIFICATION OF NON-SEGREGATED FACILITIES

The Bidder certifies that he/she does not maintain or provide for his/her employees any segregated facilities at any of his establishments, and that he/she does not permit his/her employees to perform their services at any location, under his/her control, where segregation facilities are maintained. The Bidder agrees that a breach of this certification will be a violation of the Equal Opportunity Clause in any contract resulting from acceptance of this Bid. As used in this certification, term "segregation facilities" means any waiting rooms, work rooms, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employee which are segregated by explicit directive or are in fact segregated on basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. The Bidder agrees that (except where he/she has obtained identical certification from proposed subcontractors for specific time periods) he/she will obtain identical certification from proposed subcontractor prior to the award of subcontracts exceeding \$10,000.00 which are not exempt from provisions of the Equal Opportunity Clause, and that he/she will retain such certifications in his/her files.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. & 1001.

DATE _____, 20__

Name of Bidder and Official Address:

E-Mail: _____

Name of Authorized Representative (Contact):

By _____
(Signature)
Title _____

Phone: _____

**Bidder shall indicate, in space provided,
the earliest possible Project Start-up Date:** _____, 20__

ADDENDA: The undersigned acknowledges receipt of the following Addenda, if any, and has included the provisions thereof in this Bid (If Any):

<u>Addendum No.</u>	<u>Date</u>
_____	_____, 20__
_____	_____, 20__

<u>Addendum No.</u>	<u>Date</u>
_____	_____, 20__
_____	_____, 20__

Sub-Contractors (If Any):

Name: _____	Scope of Work: _____	MBE / WBE
Name: _____	Scope of Work: _____	MBE / WBE
Name: _____	Scope of Work: _____	MBE / WBE



**BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND**

SUPPLEMENTAL BID FORM

**HVAC UPGRADES TO THE ROGER WILLIAMS PARK MUSEUM OF NATURAL HISTORY AND
PLANETARIUM -REBID-**

BASE BID: Work of the Project includes the upgrading of the HVAC system at the Roger Williams Park Natural History Museum as described on the drawings and in this project manual.

In addition to stating the Total Base Bid, The bidder shall state Unit Prices for related work listed under each bid item which represents the work items included in the Total Base Bid. The Unit Prices are quoted for computing adjustments to the Base Bid prior to Contract award, as well as during the course of construction, based upon extra work ordered by the City or for work countermanded, reduced or omitted by the City in order to stay within the Project budget.

Base Bid Items and Unit prices are to be Completed prices to be added or deducted on the basis of quantities of work involved, for each item in place in the unit indicated.

BASE BID: The Base Bid scope of work for this project shall include, but not be limited to the following:
Upgrading of the HVAC system at the Roger Williams Park Natural History Museum as described on the drawings and in this project manual.

All Work Included in this Project Shall be Completed for the lump sum of:

Dollars

(\$ _____), TOTAL BASE BID

UNIT PRICES:

None

Please note that the list above is not intended to include all items required to complete the base bid scope of work but can and shall be used to adjust the contract prior to or after award – in the best interest of the City of Providence.

BIDDER: _____

BID DOCUMENTS:

The complete set of Bid Documents consists of the Bid Form, Technical Specifications, Minority Participation Forms, and the following Drawings:

DRAWINGS:

- A1.0 BASEMENT FLOOR PLAN



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- A1.1 1st FLOOR PLAN
- A1.2 2nd FLOOR PLAN
- A1.3 3rd FLOOR PLAN
- A5.1 ROOF PLAN & DETAILS
- A8.1 2nd FLOOR REFLECTED CEILING PLAN
- A8.2 3rd FLOOR REFLECTED CEILING PLAN
- M0.01 MECHANICAL GENERAL (INDEX, SYMBOLS, LEGEND, NOTES, ABBR, LOCATION MAP)
- M0.01 MECHANICAL GENERAL (INDEX, SYMBOLS, LEGEND, NOTES, ABBR, LOCATION MAP)
- M1.00 (D) MECHANICAL PLANS (BASEMENT)
- M1.01 (D) MECHANICAL PLANS (FIRST FLOOR)
- M1.02 (D) MECHANICAL PLANS (SECOND FLOOR)
- M1.03 (D) MECHANICAL PLANS (THIRD FLOOR)
- M1.04 (D) MECHANICAL PLANS (ROOF)
- M1.10 (N) MECHANICAL PLANS BASEMENT
- M1.11 (N) MECHANICAL (FIRST FLOOR ZONES)
- M1.12 (N) MECHANICAL (SECOND FLOOR ZONES)
- M1.13 (N) MECHANICAL (THIRD FLOOR ZONES)
- M1.14 (N) MECHANICAL (ROOF FLOOR ZONES)
- M3.01 MECHANICAL SECTIONS
- M5.01 MECHANICAL DETAILS
- M5.02 MECHANICAL DETAILS
- M6.01 MECHANICAL SCHEDULES
- M8.00 SEQUENCE OF OPERATIONS
- E0.01 ELECTRICAL GENERAL (INDEX, SYMBOLS, LEGEND, NOTES, ABBREVIATION)
- E0.02 SINGLE LINE
- E1.00 (D) ELECTRICAL PLANS (BASEMENT)
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- E1.13 (N) ELECTRICAL PLANS (THIRD FLOOR)
- E2.01 PANEL SCHEDULES
- E2.02 PANEL SCHEDULES

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- 01 31 00 Administrative Requirements
- 01 33 00 Submittal Procedures
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- 01 50 00 Temporary Facilities and Controls
- 01 60 00 Product Requirements
- 01 70 00 Execution Requirements
- 01 74 19 Waste Materials Management and Recycling
- 01 78 00 Closeout Submittals
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- 01 91 13 General Commissioning Requirements
- 02 41 19 Selective Demolition
- 02 65 00 Underground Storage Tank Removal
- 02 83 13 Lead Paint Consideration
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- 06 20 10 Carpentry and Millwork
- 07 50 01 Repairs to Existing Roof
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- 23 01 30.51 HVAC Air Distribution System Cleaning
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ADDITIONAL INFORMATION REQUIRED WITH BID:

- Qualifications to Perform Work – See Form Below for Information Required
- Minority Participation Forms – 10% MBE / 10 % WBE Goal on this Project
- Addenda (If Any) - Must Be Acknowledged on Bid Form
- Product Information for Items Submitted as ‘Or Equal’ to Specified Materials

PROVISIONS OF THIS PROJECT:

- Upon the Issuance of the Award from the Board of Contract – the City shall issue a Contract to be executed by the City and the vendor incorporating the bid specifications. All Provisions of the Specifications are binding.
- Any Permits Required by the City of Providence and/or State of Rhode Island Shall be Obtained by the Vendor – Permit Fees by the City of Providence Shall be Waived – the State ADA Fee Must be Paid
- The Prevailing Wage Act Applies – Prevailing Wages Must Be Paid for On Site Hours – On-Site Interviews will be Conducted During the Project – Employees Shall be Advised of the Prevailing Wage Rates Prior to Mobilization on Site
- Certified payrolls Must be Submitted with Pay Requests Including Monthly Utilizations Form
- Performance and Payment Bonds (If Required) Must be Submitted within 10 Days of Award or Bid Bond Will be Forfeited
- An Insurance Certificate Shall be Submitted to the City Within 10 Days of Award
- A Copy of the Vendors Contractor’s License Must be Submitted within 10 Days of Award
- All On-Site Personnel Shall be Licensed (If required) and Shall have Proof of All Licenses Required by the State of Rhode Island to Perform the Work Required
- Pay Requests Must be Submitted on Approved AIA Billing Documents (City will Provide if Needed)
- All Subcontractors Shall be Listed on the Bid Form – All Insurance & Payroll Requirements Apply
 - General Contractor Shall be the Insurance Certificate Holder and the City Shall be Named as ‘Additionally Insured’ with Respect to Liability Insurance
- A Submittal Log Must be Submitted within 10 Days of Award

CLOSE OUT DOCUMENTS:

- Prior to Final Payment the Vendor Shall Provide the Following:
 - Copies of Permits Signed off and Approved (If Any)
 - Operating Manuals and Warranties Shall Be Transferred and/or Delivered
 - Full and Completed As-Built Drawings Shall be Submitted for Approval
 - Training Shall be Provided to City Personnel (If Required)
 - Certification by Manufactures Representative (If Required)



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QUALIFICATIONS:

Qualifications will be evaluated on the basis of similar project experience for:

- a. Completion of at least 3 similar projects within the past five years.
- b. Size and dollar value of similar completed projects.
- c. Contractor's performance with similar projects. (references will be checked)
- d.. Relevant experience of individuals assigned to the project.

This project qualifies for prevailing wages per the Prevailing Wages Statute. Certified payrolls will need to be submitted to the owner for all hours worked on site for this project.

The Wage Decision for this project shall be as recorded on the Bid Date and is available on the RI Department of Labor website.

Questions regarding this bid package shall be submitted via e-mail to **Patti Jordan** at pjordan@providenceri.gov and **Brian Byrnes, Deputy Superintendent of Parks** at bbyrnes@providenceri.gov , no later than five (7) working days before the bid opening date.

Brian Byrnes is the project contact and can be reached at 401-660-9308.



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

[SAMPLE CONSTRUCTION AGREEMENT]

This Construction Agreement ("Agreement") is made and entered into as of this _____ day of _____ 2022 by and between the **City of Providence Board of Park Commissioners**, having an address of The Dalrymple Boathouse, Roger Williams Park, 1000 Elmwood Ave., Providence, RI ("City") and **[Contractor Name]**, ("Contractor"), having an address of **[Contractor Address]**.

WITNESSETH:

WHEREAS, the **[Project Location]** is located at **[Project Address], Providence, RI**. The City plans to make improvements in the park under the **[Project Title]** project (the "Project"), all as detailed in Request for Proposals ("RFP") issued by the City on **[Date of Bid Advertisement]** (attached and incorporated by reference as Exhibit A); and

WHEREAS, the Contractor proposed to handle the Project, as detailed in a responsive bid opened on **[Date of Bid Opening]** (attached and incorporated by reference as Exhibit B); and

WHEREAS, the Board of Contract and Supply awarded the contract to **[Contractor Name]**, at its meeting on **[Date of Award]**.

NOW, THEREFORE, in consideration of the mutual covenants and agreements contained in this Agreement, the Parties agree as follows:

1. **SELECTION.** The City hereby selects the Contractor to provide construction services outlined in its **[Date of Bid Opening]** submission.
2. **TERM.** The term of this agreement shall be from and after the date of execution through completion of the Project, which shall be not later than **[Contract Completion Date]**.
3. **TERMS OF PAYMENT.** The total amount of the awarded contract is **[Contract Award Amount]**. The City shall make a good-faith effort to pay the Contractor within sixty (60) days of receipt of a pay requisition for work completed and accepted, less retainage.
4. **COMPENSATION.** The Contractor shall be paid according to the breakdown contained in its bid package.
5. **INDEMNIFICATION AND LIABILITY.** The Contractor is alone responsible for the safety, efficiency, and adequacy of the construction and for any damage which may result from improper construction, maintenance, or operation. The contractor shall indemnify, defend, and hold harmless the City, and its employees, representatives, agents, successors and assigns (the "City Indemnified Parties") from and against any and all demands, claims, suits, cause or cause of action, whether at law or in equity, costs, expenses and attorneys' fees and any liability whatsoever to anyone for any bodily injury or property damage resulting from or arising out of the willful misconduct or negligent acts or



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omissions of the Contractor and/or its employees, representatives, subcontractors, and agents in the performance of this Agreement.

6. **RETAINAGE:** The City shall retain **5%** of all pay requests paid during the project. When the City and/or its representatives deem the project as “Substantially Complete” or 85% of the work has been completed, the retainage may be reduced to 2.5% for the work completed. The final payment will be released when all the work has been completed, inspected, and approved by the owner’s representative and all close out documents, warranties and as-built plans have been received and approved by the City.
7. **INSURANCE.** The Contractor shall furnish an insurance certificate naming the City as an additional named insured on a primary but non-contributing basis for General Liability.
8. **BINDING EFFECT.** This contract and all the covenants, provisions, and conditions herein contained shall inure to the benefit of and be binding upon the heirs, successors and assigns of the parties. Neuter pronouns shall be read as masculine or feminine, and words in the singular person as plural, if the nature or number of the parties require.
9. **GOVERNING LAW.** This Agreement is entered into pursuant to and shall be governed by and construed in accordance with the laws of the State of Rhode Island.
10. **NATURE OF RELATIONSHIP.** Nothing in this Agreement shall create a partnership, joint venture, trust or other fiduciary relationship between the Contractor and the City.
11. **AMENDMENTS AND SUPPLEMENTS.** The Contractor and the City may amend, modify, supplement, or waive any provisions of this Agreement in such manner as may be agreed upon by the Parties in a written instrument executed by both Parties.
12. **MBE/WBE.** The parties acknowledge that the City sets an MBE goal of 10% and a WBE goal of 10%, and the Contractor will make good faith efforts to comply with these goals.
13. **TERMINATION.** The City may terminate this Agreement at any time upon ninety (90) days prior written notice. This Agreement may be terminated by either party if the other party materially breaches any provision of this Agreement and fails to cure the material breach within 30 days after receiving notice thereof from the non-breaching party. Without limiting the City’s right to terminate this Agreement, the City may suspend the Contractor’s right to access the Project upon any actual, threatened, or suspected breach of this Agreement.
14. **COUNTERPARTS.** This Agreement may be executed in multiple counterparts, each of which shall constitute an original, but all of which shall constitute one document.



BOARD OF CONTRACT AND SUPPLY

CITY OF PROVIDENCE, RHODE ISLAND

IN WITNESS WHEREOF, the parties have caused this Agreement to be duly executed as of the date first above written.

City of Providence

By: _____
Jorge O. Elorza, Mayor

STATE OF RHODE ISLAND
PROVIDENCE, SC.

In Providence, in said County and State, on the ____ day of _____, 2022, before me personally appeared Jorge O. Elorza, Mayor and Chairman of the Board of Park Commissioners, to me known and known by me to the party executing the foregoing instrument for and on behalf of the City, and he acknowledged said instrument by him executed to be his free act and deed, his free act and deed in his capacity as aforesaid, and the free act and deed of the City.

Notary Public
My Commission Expires:

Approved as to form and satisfactory to me:

City Solicitor

[Contractor Company Name]

By: _____
[Owners Name]
[Title]

STATE OF RHODE ISLAND
PROVIDENCE, SC.



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

In Providence, in said County and State, on the ____ day of _____, 2022, before me personally appeared **[Owners Name]** to me known and known by me to the party executing the foregoing instrument for and on behalf of **[Owners Name]** and he/she/they acknowledged said instrument by him/her/they executed to be his/her/their free act and deed, his/her/their free act and deed in his/her/their capacity as aforesaid, and the free act and deed of **[Contractor Company Name]**.

Notary Public
My Commission Expires:



BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

TECHNICAL SPECIFICATIONS

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DOCUMENT 00 65 19.16

WAIVER OF LIEN FORM

The Waiver of Lien Form is included, following this page, as an integral part of the Contract documents. A copy with completed information must be submitted with the second and each succeeding Application for Payment.

WAIVER OF LIEN FORM
Material or Labor

Construction Project Title: _____

General Contractor: _____

Subcontractor/Supplier: _____

General Contractor's previous Application No: _____

General Contractor's previous Application Date: _____

Schedule of Values Line Item No.: _____

DESCRIPTION OF WORK Heading: _____

Total payment Received to Date:

\$ _____

The undersigned Representative of the above Subcontractor/Supplier has been contracted by the above General Contractor to furnish materials, or labor, or both, as included in the approved Schedule of Values under the Line Item No., and DESCRIPTION OF WORK heading indicated above, for the Construction Project listed above.

The undersigned acknowledges receipt of payment, under this Line Item No., and DESCRIPTION OF WORK heading, and hereby waives and releases any and all lien, or claim or right to lien, on the Construction Project listed above, and premises, under the statutes of the State of Rhode Island, relating to Mechanics Liens, on account of materials, or labor, or both, furnished, or which may be furnished, by the undersigned to, or on account of, the above numbered and dated Application and Certificate for Payment.

Signed this month of _____ day of _____, 20__.

(signature)

(company/firm name)

END OF DOCUMENT

DOCUMENT 00 65 19.18

**AFFIDAVIT OF GENERAL CONTRACTOR THAT ALL SUBCONTRACTORS,
SUPPLIERS AND LABORERS HAVE BEEN PAID AND HOLD HARMLESS CLAUSE**

The affidavit is included, following this page, as an integral part of the bid documents, for submittal with all applications for payment.

DOCUMENT 00815

AFFIDAVIT OF GENERAL CONTRACTOR
THAT ALL SUBCONTRACTORS, SUPPLIERS AND LABORERS
HAVE BEEN PAID: AND HOLD HARMLESS CLAUSE

To: ????????????

The undersigned hereby deposes, says and makes affidavit under oath that he/she is _____ of _____ and further certifies that as of today's date all monies previously advanced pursuant to requisitions of the Contractor in connection with the Project known as _____ have been paid to or are being held for and will be paid to the subcontractors, laborers, or suppliers: that there are no further amounts owing to the knowledge of the undersigned other than as set forth in the current requisition, a copy of which is attached hereto, and that only materials, fixtures, and equipment to which undersigned has absolute title have been used in the project. Further, the undersigned HEREBY HOLDS HARMLESS THE CITY OF PROVIDENCE AND ALL COMMITTEES, BOARDS, DEPARTMENTS AND AGENCIES THEREUNDER, AND AGREES TO INDEMNIFY SAME FOR ANY ACTION OR SUIT BROUGHT BY ANY SUBCONTRACTOR, LABORER, OR SUPPLIER FOR THE PAYMENT OF ANY SUMS DUE RELATIVE TO The AFORESAID PROJECT. Said Hold Harmless Clause and Indemnification shall cause the undersigned to shield the City of Providence and all committees, boards, departments and agencies from all attachments, chattel mortgages, and all liens, whatsoever, sought by subcontractors, laborers and/or suppliers for collection of monies allegedly due said parties for work performed on the aforesaid Project.

On the _____ day of _____, 20____, before me
appeared _____, where upon oath said
property executed the foregoing Affidavit as their free act and deed.

NOTARY

My commission expires:

DOCUMENT 00 72 13

GENERAL CONDITIONS

AIA Document A201, General Conditions of the Contract for Construction - 2017 Edition, is included, following this page, as an integral part of the Bidding and Contract Documents. Provisions which are not amended or supplement remain in full force and effect.

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AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following **PROJECT**:
(Name and location or address)

HVAC Upgrades
Roger Williams Park Natural History Museum
1000 Elmwood Ave., Providence, RI 02905

THE OWNER:
(Name, legal status and address)

City of Providence
City Hall
25 Dorrance Street
Providence, Rhode Island

THE ARCHITECT:
(Name, legal status and address)

Saccoccio & Associates, Architects
1085 Park Avenue
Cranston, RI 02910

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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User Notes:

(3B9ADA35)

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Init.

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User Notes:

(3B9ADA35)

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents consist of the Agreement between the Owner and Contractor (hereinafter, the Agreement), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents include the advertisement or invitation to bid, Instructions to Bidders, sample forms, information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, and Addenda relating to those documents.

In the event of any conflict among the Contract Documents, the Documents shall be construed according to the following priorities:

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by

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one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results. All Work mentioned or indicated in the Contract Documents shall be performed by the Contractor as part of this Contract unless it is specifically indicated in the Contract Documents that such Work is to be done by others. Should the Drawings or the Specifications disagree in themselves or with each other, the Contractor shall provide the better quality or greater quantity of Work unless otherwise directed by written addendum to the Contract.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. The Contractor and all Subcontractors shall refer to all of the Drawings, including those showing primarily the Work of the mechanical, electrical and other specialized trades, and to all of the Sections of the Specifications, and shall perform all Work reasonably inferable therefrom as being necessary to produce the indicated results.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 All indications or notations which apply to one of a number of similar situations, materials or processes shall be deemed to apply to all such situations, materials or processes wherever they appear in the Work, except where a contrary result is clearly indicated by the Contract Documents.

§ 1.2.5 Where codes, standards, requirements and publications of public and private bodies are referred to in the Specifications, references shall be understood to be to the latest revision prior to the date of receiving bids, except where otherwise indicated.

§ 1.2.6 Where no explicit quality or standards for materials or workmanship are established for Work, such Work is to be of good quality for the intended use and consistent with the quality of the surrounding Work and of the construction of the Project generally.

§ 1.2.7 All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the manufacturer's written or printed directions and instructions unless otherwise indicated in the Contract Documents.

§ 1.2.8 All drawings are diagrammatic and indicate general arrangement of systems and equipment, except when specifically dimensioned or detailed. For exact locations of building elements, refer to dimensioned drawings. Field measurements take precedence over dimensioned drawings. Intention is to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement. Installation of all systems and equipment is subject to clarification as indicated in reviewed shop drawings and field coordination drawings.

Dimensions indicated on contract drawings are limiting dimensions. Do not use equipment exceeding dimensions indicated or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.

§ 1.2.9 The Mechanical, Plumbing, Electrical and Fire Protection Drawings are diagrammatic only, and are not intended to show the alignment, physical locations or configurations of such Work. Such Work shall be installed without additional cost to the Owner to clear all obstructions, permit proper clearances for the Work of other trades, and present an orderly appearance where exposed. Prior to beginning such Work, the Contractor shall prepare coordination drawings showing the exact alignment, physical location and configuration of the Mechanical, Plumbing, Electrical and Fire Protection installations and demonstrating to the Contractor's satisfaction that the installations will comply with the preceding sentence. A copy of the drawings shall be submitted to the Architect, and the Contractor shall revise and resubmit the drawings if so directed by the Architect.

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§ 1.2.10 Exact locations of fixtures and outlets shall be obtained from the Architect as provided in subparagraph 3.2.5 before the Work is roughed in; Work installed without such information from the Architect shall be relocated at the Contractor's expense.

§ 1.2.11 Test boring or soil test information included with the Contract Documents or otherwise made available to the Contractor was obtained by the Owner for use by the Architects in the design of the Project or Work. The Owner does not hold out such information to the Contractor as a completely accurate indication of subsurface conditions, and no claim for extra cost or extension of time resulting from a reliance by the Contractor on such information shall be allowed except as provided in subparagraph 3.7.4.

§ 1.2.12 Where the Work is to fit with existing conditions or work to be performed by others, the Contractor shall fully and completely join the Work with such conditions or work, unless otherwise specified. Owner provided drawings showing existing conditions or construction are based on available documents and are not guaranteed to show actual existing conditions.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 All Drawings, Specifications and copies thereof furnished by the Owner are and shall remain the Owner's property. They are to be used only with respect to this Project and are not to be used on any other project without the prior written consent of the Owner. With the exception of one contract set for each party to the Contract, such documents are to be returned or suitably accounted for to the Owner at the completion of the Work. Submission or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of any reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

(Paragraph Deleted)

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Not Used.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

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§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish available surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner except to the extent that the Contractor's review thereof reveals, or in the exercise of reasonable diligence should have revealed, any inaccuracy or incompleteness therein. The Owner makes no warranty as to the accuracy or completeness of such information. The Contractor shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 Information or services required of the Owner by the Contract Documents shall be furnished by the Owner with reasonable promptness after receipt from the Contractor of a written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, 5 copies of Drawings and Project Manuals. All additional hard copies will be furnished upon request at the cost of reproduction.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. The Contractor shall resume the Work after such stoppage promptly upon written notice to do so from the Owner. The Contractor shall remain responsible for maintaining the progress of the Work and shall not be entitled to any increase in the Contract Sum or Contract Time. The Contractor shall be responsible for all costs incurred by the Owner attributable to such an order to stop the Work.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's and Owner's Project Manager's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

The rights of the Owner hereunder are in addition to any other rights set forth in the Contract Documents or available at law or in equity.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents. The Contractor shall not be entitled to any change in the Contract Time or Contract Sum on account of its failure, or that of any Subcontractor, to comply with the foregoing requirements.

§ 3.2.2 Because the Contract Documents are complementary, the 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 the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. The Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. If the Contractor performs any construction activity that it knows or should know involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Architect, the Contractor shall assume appropriate responsibility for such performance and shall bear responsibility for the costs of any required correction.

§ 3.2.3 The Contractor is required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities. The Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations.

§ 3.2.5 Any claim by the Contractor, in submitting their bid, they did not include all items as shown in the Contract Documents, will be given no consideration for an adjustment of any kind.

§ 3.2.6 The Contractor shall give the Architect timely notice of any additional Drawings, Specifications, or instructions required to define the Work in greater detail, or to permit the proper progress of the Work.

§ 3.2.7 The Contractor shall not proceed with any Work not clearly and consistently defined in detail in the Contract Documents, but shall request additional drawings or instructions from the Architect as provided in subparagraph 3.2.5. If the Contractor proceeds with such Work without obtaining further Drawings, Specifications or instructions, the Contractor shall correct Work incorrectly done at the Contractor's own expense.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the work using the Contractor's best skill and attention which shall not be less than such state of skill and attention generally rendered by the contracting profession for projects similar to the Project in scope difficulty and location.

The Contractor shall adequately staff the Project to properly and thoroughly manage, schedule and supervise all construction activities.

The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contractor unless the Contract Documents give other specific instructions concerning these matters. Where the contract documents refer to particular construction means, methods, techniques, sequences or procedures or indicate or imply that such are to be used in the Work, such mention is intended only to indicate that the operations of the Contractor shall be such as to produce at least the quality of work implied by the operations described, by the actual determination of whether or not the described operations may be safely and suitably employed on the Work shall be the responsibility of the Contractor, who should notify the Architect in writing of the actual means, methods, techniques, sequences or procedures which will be employed on the Work, if these differ from those mentioned in the Contract Documents.

All loss, damage, or liability, or cost of correcting defective work arising from the employment of any construction means, methods, techniques, sequences, or procedures shall be corrected at Contractor's expense, notwithstanding that such construction means, methods, techniques, sequences, or procedures are referred to, indicated or implied by the Contract Documents, unless the Contractor has given timely notice to the Owner and Architect in writing that

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such means, methods, techniques, sequences or procedures are not safe or suitable, and the Owner has then instructed the Contractor in writing to proceed at the Owner's risk.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors. This obligation shall also extend to the presence on the Site of suppliers of materials or equipment, their employees, contractors, and agents engaged in the Work.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them, and the Contractor shall ensure that all workers to be employed on the Project have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration (OSHA) of at least 10 hours. The Contractor shall be responsible for maintaining all safety precautions at and around the Project site. On the Owner's request, the Contractor shall permanently remove from the Project site any employee of the Contractor or any Subcontractor who fails to comply with the requirements of the Contract Documents or whose presence or behavior is deemed by the Owner to be adverse to the success of the Project or the Owner's interests.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise and, promptly after written notification of non-conformance, shall be repaired or replaced by the Contractor with Work conforming to such requirements.

The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

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3.5.3

The Contractor shall be responsible for determining that all materials furnished for the Work meet all requirements of the Contract Documents. The Architect may require the Contractor to produce reasonable evidence that a material meets such requirements, such as certified reports of past tests by qualified testing laboratories, reports of studies by qualified experts, or other evidence which, in the opinion of the Architect, would lead to a reasonable certainty that any material used, or proposed to be used, in the Work meets the requirements of the Contract Documents. All such data shall be furnished at the Contractor's expense. This provision shall not require the Contractor to pay for periodic testing of different batches of the same material, unless such testing is specifically required by the Contract Documents to be performed at the Contractor's expense.

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§3.5.4 The Contractor shall guarantee all Work for a period of **one year** after Date of Substantial Completion, or by the terms of any special guarantee required by the Contract Documents. The Contractor shall, upon written notice from the Owner, promptly correct defective Work or Work not in accordance with the Contract Documents.

§ 3.6 Taxes

The Owner is exempt from Rhode Island sales tax on products permanently incorporated in Work of the Project.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

The City of Providence has waived all permit fees. The Contractor is still required to file an application and obtain all pertinent permits before construction and pay all inspection fees. The State ADA fee must be paid by the Contractor.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work. If any of the Work is required to be inspected or approved by any public authority, the Contractor shall cause such inspection or approval to be performed and shall comply with any instructions or corrections ordered by the public authority.

§ 3.7.3 If the Contractor performs Work it knows or should know to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4

(Paragraph Deleted)

If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents.

(Paragraphs Deleted)

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ, in accordance with the Contract Documents, a competent superintendent and necessary assistants who shall be in attendance at the Project site at all times during performance of the Work until the date of Substantial Completion, and for such time thereafter as the Architect may determine to be necessary for the expeditious completion of the Work. The Contractor shall remove the superintendent if requested in writing by the Owner, and shall replace him/her with a competent person reasonably acceptable to Owner.

The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

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§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.9.4 The Contractor shall coordinate and supervise the Work performed by Subcontractors to the end that the Work is carried out without conflict between trades and so that no trade, at any time, causes delay to the general progress of the Work. The Contractor and all Subcontractors shall at all times afford each trade, any separate contractor, or the Owner, every reasonable opportunity for the installation of Work and the storage of materials.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, within twenty (20) calendar days after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Projector as requested by the Architect.

The construction schedule shall be in such form and contain such information as the Architect and Owner require.

The construction schedule shall be resource loaded for the Contractor and all subcontractors, with each resource identified by name, description, unit of measure, and calendar assignment. For each class of work included in the Contractor's schedule of values, the construction schedule shall show the percentage of completion to be obtained and the total dollar value of the work to be completed as of the first of each month until Substantial Completion. All calculations shall be on the basis of work in place, but not including the value of materials delivered but not in place.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

The Contractor's compliance with the construction schedule is a material obligation of the Contract.

§ 3.10.4 The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays. The construction schedule shall be updated every month (or more frequently if requested by the Owner) to reflect actual conditions (such updates are sometimes referred to in these General Conditions as "progress reports"). In the event any progress report indicates delays in achievement of any milestone date set forth in such schedule, the Contractor shall propose in written form an affirmative plan (the "Recovery Schedule") to correct the delay, including overtime and/or additional labor, if necessary, which Recovery Schedule shall indicate the date by which the progress of the Work will comply with the construction schedule, and shall be subject to the approval of the Owner and the Architect. In no event shall any progress report or Recovery Schedule constitute an adjustment in the construction schedule, Contract Time or any milestone date unless any such adjustment is agreed to by the Owner and authorized pursuant to a Change Order.

§ 3.10.5 In the event (i) that the performance of the Work, as of a milestone date, has not progressed or reached the level of completion required by the construction schedule, and (ii) the progress of the Work is not brought back into compliance with the construction schedule on the date proposed by the Recovery Schedule, or the Contractor otherwise fails to comply with the Recovery Schedule, the Owner shall have the right to order the Contractor to take

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corrective measures to expedite the progress of the Work, including, without limitation, (1) supplying additional manpower, equipment, and facilities, (2) working additional shifts or overtime, (3) working additional days, and (4) other similar measures (hereinafter referred to collectively as "Corrective Measures"). Such Corrective Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents.

§ 3.10.6 The Contractor shall not be entitled to an adjustment in the Contract Sum in connection with Corrective Measures required by the Owner under or pursuant to Section 3.10.5. The Owner may exercise the rights furnished the Owner under or pursuant to Section 3.10.5 as frequently as reasonably necessary to ensure that the Contractor's performance of the Work complies with the milestone dates set forth in the construction schedule.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. By approving and submitting Shop Drawings, Product Data, Samples, and similar submittals the Contractor thereby represents that the Contractor has determined and verified all dimensions, quantities, field dimensions, relations to existing work, coordination with work to be installed later, coordination with information on previously accepted Shop Drawings, Product Data, Samples, or similar submittals and verification of compliance with all the requirements of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor. In reviewing Shop Drawings, Product Data, Samples, and similar submittals the Architect shall be entitled to rely upon the Contractor's representation that such information is correct and accurate.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect. The accuracy of all such information is the responsibility of the Contractor. In reviewing Shop Drawings, Product Data, Samples, and similar submittals the Architect shall be entitled to rely upon the Contractor's representation that such information is correct and accurate.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.12.11 When professional certification of materials, systems or equipment is required by the Contract Documents, the Owner shall be entitled to rely upon such certifications, and neither the Owner nor the Architect shall be expected to make an independent examination with respect to the performance of such materials, systems or equipment.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

The right of possession of the premises and the improvements made thereon by the Contractor shall remain at all times with the Owner. The Contractor's right to entry and use thereof arises solely from the permission granted by the Owner under the Contract Documents. The Owner shall not be liable to the Contractor, the Subcontractors, their employees, or anyone else with respect to the conditions of the premises, except only for a condition caused directly and solely by the negligence of

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the
Owner.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project site.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor and may deduct all costs thereof from any payment due the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner, Owner's representatives, and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, including claims, damage, loss or expense attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, including the Work, caused in whole or in part by the negligent or wrongful acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations, including those of indemnity, which would otherwise exist as to a party or person described in this section.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

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§ 3.18.3 The obligations of the Contractor under this paragraph 3.18 shall not extend to the liability of the Architect, the Architect's consultants, and agents or employees of any of them arising out of (1) the preparation of maps, Drawings, opinions, reports, surveys, Change Orders, designs or Specifications, or (2) directions or instructions given by the Architect, the Architect's consultants and agents or employees of any of them, provided such instructions or directions are the primary cause of the injury or damage.

§ 3.18.4 The Owner and the Architect have acknowledged that nothing in the Architect's engagement implies any undertaking by the Architect for the benefit of or which may be enforced by the Contractor, its Subcontractors, or the surety of any of them; it being understood that the Architect's obligations are to the Owner and that, in performing such obligations, the Architect may increase the burdens and expense of the Contractor, its Subcontractors or the surety of any of them. Neither the Contractor, any Subcontractor, nor the surety of any of them shall bring any civil suit or other legal action against the Architect arising out of or in connection with the Project.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner and Architect. Consent of the Owner shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 Not Used

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract

Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable and legally permissible objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. No increase in the Contract Sum or Contract Time shall be allowed for such change.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Article 14 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor;
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the

Contract; and
(Paragraph Deleted)

- .3 the Owner may further assign the subcontract to a successor contractor or other entity.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the

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Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 The Owner reserves the right to enter any part of the Project site at any time to inspect the Work or to perform other work with its own forces or separate contractors, or to address any emergency situation. Such access is not to be construed to mean partial occupancy by the Owner and no claim for increase in the Contract Time or Sum will be considered unless such Owner's contractors have delayed or damaged the Contractor's Work. The Contractor shall permit the Owner to place and install as much furniture, equipment and other material during the progress of the Work as is possible before completion of the various parts of the Work and agrees that such placing and installation of equipment shall not in any way evidence the completion or acceptance of the Work or any portion of it.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

(Paragraph Deleted)

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 Upon request of the Owner or the Architect, the Contractor shall without cost to the Owner submit to the Architect, in such form as the Architect may require, an accurate written estimate of the cost of any proposed extra Work or change. The estimate shall indicate the quantity and unit cost of each item of material, and the number of hours of work and hourly rate for each class of labor, as well as a description and the amounts of all other costs chargeable under the terms of this Article. Unit labor costs for the installation of each item of material shall be shown if required by the Architect. The Contractor shall promptly revise and resubmit each estimate if the Architect determines that it is not in compliance with the requirements of this Article, or that it contains errors of fact or mathematical errors. If required by the Architect, in order to establish the exact cost of new Work added or of previously required Work omitted, the Contractor shall obtain and furnish to the Architect bona fide proposals from recognized suppliers for furnishing any material included in such Work. Such estimates shall be furnished promptly so as to occasion no delay in the Work, and shall be furnished at the Contractor's expense. The Contractor shall state in the estimate any extension of time required for the completion of the Work if the change or extra work is ordered.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, and if the Contract Documents include a unit price for the work that is the subject of such directive, such unit price shall be the basis of the adjustment to the Contract Sum, unless the Owner, in its sole discretion, chooses another method. If, however, the Contract Documents do not include a unit price for such work, the adjustment shall be based on one of the following methods, as selected by the Owner:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the proposed method of adjustment in the Contract Sum is based on unit prices that are stated in the Contract Documents, such unit prices shall be the basis of any adjustment to the Contract Sum, unless the Owner has chosen another method pursuant to subparagraph 7.3.3. If the proposed method of adjustment is not based on such unit prices and the Contractor objects to the proposed method of

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adjustment, the Contractor must notify the Architect of such objection in writing within five (5) calendar days from Contractor's receipt of the Construction Change Directive. Failure to so object will irrevocably waive any such objections and claims on account of such method of adjustment, and the Construction Change Directive shall be deemed and shall constitute a Change Order. If the Contractor does so object, the adjustment to the Contract Sum shall be determined by the Architect on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an allowance for overhead and profit in accordance with the Clauses 7.3.11.1 through 7.3.11.6 below.

In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds, insurance and permit fees directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be deemed a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to all changes for any given trade.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner amounts for such changes in the Work shall not be included in Applications for Payment. Such amounts shall only be included in an Application for Payment after the adjustment for the Construction Change Directive has been included in a Change Order signed by the Owner and the Contractor. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.3.11 The allowance for the combined overhead and profit is to be as listed below.

- .1 For the Contractor, for Work performed by the Contractor's own forces, 10 percent of the cost.
- .2 For the Contractor, for Work performed by the Contractor's Subcontractor, 5 percent of the amount due the Subcontractor.
- .3 For each Subcontractor involved, for Work performed by that Subcontractor's own forces, 10 percent of the

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cost.

- .4 Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.4.
- .5 Overhead and profit is to include the Contractor's project management and supervisory costs, all administrative expenses and personnel, change estimate preparation, mobilization, setup & break-down, meetings, all safety related costs, cleanup costs and storage costs pertaining to the changes in the work.
- .6 The fee increase to any permit required by the additional work is allowed to be added to the Change Order costs. However, the Contractor is required to submit proof that the additional fee was paid to the presiding authority.
- .7 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change involving over \$500.00 be approved without such itemization.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.2.4 Unless specifically required by law, no payment under this Contract shall be due until the construction schedule, required by Section 3.10, and conforming to the requirements of the General Requirements has been accepted by the Architect.

§ 8.2.5 If the Architect in reviewing any Application for Payment determines that the amount of completed Work in place as certified by the Architect is less than 90% of the Work in place required by the Contractor's construction schedule or schedule of values provided for in Section 9.2, or that there have been delays to critical paths and the Contract completion date will not be met, or that, in the Owner's sole discretion, there is reasonable concern that the Work will not be Substantially Complete by the date required in the Contract Documents, the Contractor shall be required to submit a recovery schedule with a written description of the steps the Contractor intends to take to put

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the Project back on schedule. At the Owner's option, the Contractor shall take some or all of the following actions at no additional cost to the Owner:

- .1 Increase the number of workers on the site, in such quantities and trades as will substantially eliminate the backlog of work;
- .2 Increase the number of working hours per shift, shifts per day, working days per week, amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate backlog of work; or
- .3 Reschedule activities so that the completion dates initially scheduled will be met.

§ 8.2.6 If the Architect has determined that the Contractor should be permitted to extend the time for completion as provided in paragraph 8.3, the calendar dates in the Progress Schedule shall be adjusted accordingly to retain their same relationship to the adjusted date of Substantial Completion, and the dollar value of Work to be completed as of the first of each month shall be adjusted prorata.

§ 8.2.7 If the Contractor fails to submit any Application for Payment in any month, the Architect shall, for the purpose of this evaluation of progress, certify separately to the actual value of the Work in place completed as of the first of the month to the best of the Architect's knowledge.

§ 8.2.8 Nothing herein shall limit the Owner's right to liquidated or other damages for delays by the Contractor or to any other remedy which the Owner may possess under other provisions of the Contract Documents or by law.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine, and this shall be the Contractor's sole remedy for such delay. Under no circumstances will the Contractor be entitled to an increase in the Contract Sum, or to any other damages, on account of or in connection with any delay, regardless of the cause of such delay, and Contractor agrees not to make any claim for such damages, including, but not limited, claims for damages on account of having to perform out-of-sequence work, claims for damages on account of loss of production, and claims for damages on account of hindrances or interference with the work.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 No extension of time shall be granted because of seasonal or abnormal variations in temperature, humidity or precipitation, which conditions shall be wholly at the risk of the Contractor, whether occurring within the time originally scheduled for completion or within the period of any extension granted. There shall be no increase in the Contract Sum on account of any additional costs of operations or conditions resulting therefrom.

§ 8.3.4 The Contractor hereby agrees that the Contractor shall have no claim for damages of any kind against the Owner or the Architect on account of any delay in the commencement of the Work and/or any hindrance, delay or suspension of any portion of the Work, whether such delay is caused by the Owner, the Architect, or otherwise. The Contractor acknowledges that the Contractor's sole remedy for any such delay and/or suspension will be an extension of time as provided in this Article.

§ 8.4 Liquidated Damages

§ 8.4.1 It is expressly understood and agreed, by and between the Contractor and Owner, that the time for the completion of the Work described herein is a reasonable time for the completion of same, taking into consideration the average climatic range and usual industrial and/or residential conditions prevailing in this locality. If the said Contractor shall neglect, fail or refuse to complete the Work within the times herein specified, or any proper extension thereof granted by the Owner, then the Contractor does hereby agree, as a part consideration for the awarding of this Contract, to pay to the Owner the amount stipulated in these Contract Documents, not as a penalty but as liquidated damages for such breach of contract, for each and every calendar day that the Contractor shall be in default after the time stipulated for completing the Work. The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and difficulty of fixing and ascertaining the actual

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damages the Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be deducted by the Owner from periodic payments.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the maximum amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that, in the opinion of the Architect, application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment, and shall be revised if later found by the Architect to be inaccurate. In addition, the Contractor shall submit to the Architect, at least 14 days before the first Application for Payment, a Cash Flow Schedule that shows the percentage completion to be obtained and the total dollar value of Work to be completed as of the first of each month until Substantial Completion. All calculations in the Cash Flow Schedule shall be on the basis of Work in place and shall exclude the value of materials delivered but not in place.

§ 9.2.1 The Cash Flow Schedule shall be based on an orderly progression of the Work allowing adequate time for each operation (including adequate time for submission and review of submittals) and leading to a reasonable certainty of Substantial Completion by the date established in the Agreement. The Cash Flow Schedule will be reviewed by the Architect for compliance with the requirements of the Contract Documents.

Unless specifically required by law, no payment under this Contract shall be due until the Cash Flow Schedule has been reviewed and approved by the Architect. The Architect's review of the Cash Flow Schedule shall not impose any duty on the Architect or the Owner with respect to the timing, planning, scheduling or execution of the Work.

In particular if the Contractor proposes a Cash Flow Schedule indicating a date of Substantial Completion which is earlier than the Contract Time the Contractor shall not be entitled to additional payment or compensation of any kind if for any reason the full Contract Time is required to achieve Substantial Completion of the Work.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents. The form of Application for Payment shall be a notarized AIA Document G702, Application and Certification for Payment, supported by AIA Document G703, Continuation Sheet.

§ 9.3.1.1 Each Application for Payment or periodic estimate requesting payment shall be accompanied at the owner's option by (i) a waiver of liens from each Subcontractor or (ii) a certificate from each Subcontractor stating that the Subcontractor has been paid all amounts due the Subcontractor on the basis of the previous periodic payment to the Contractor, or else stating the amount not so paid and the reason for the discrepancy. In the event of any such discrepancy, the Contractor shall furnish the Contractor's own written explanation to the Owner through the Architect. Such waiver or certificate shall be in a form acceptable to the Owner.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site. The Owner may deduct the amount of such costs from payments due the Contractor.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 Subject to the Contractor's compliance with Section 9.3 and the provisions of Section 9.6, the Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;

- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the retainage currently held by the Owner would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.
- .8 failure of the Contractor or mechanical or electrical trade subcontractors to comply with requirements of the General Requirements for maintaining record drawings. The Contractor shall check record drawings each month. Written confirmation that the record drawings are current will be required by the Architect before approval of the Contractor's monthly payment requisition;
- .9 failure of the Contractor to provide required warranties under Section 9.3, claims for direct payment, or reasonable evidence indicating probable filing of such claims;
- .10 costs incurred by the Owner under Section 10.2.5;
- .11 failure of the Contractor to submit prerequisite documentation required by the General Requirements; or
- .12 liquidated damages due the Owner pursuant to Section 8.4.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 Not Used

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect. The Owner reserves the right to withhold payment to the Contractor, in whole or in part, for any or all of the reasons cited in Clauses 9.5.1.1 through 9.5.1.12.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. The Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 Not Used

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

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§ 9.6.7

Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Not Used

(Paragraph Deleted)

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

In addition, Substantial Completion for the entire Project shall be achieved only when:

- .1 the Owner has beneficial occupancy and use of the entire Project for all its intended uses;
- .2 all Project systems included in the Work are operational and acceptable to the Owner;
- .3 all governmental inspections for the Project have been successfully completed, all governmental approvals and related paperwork have been delivered to the Owner, and final and unconditional certificates of occupancy for the entire Project have been delivered to the Owner,
- .4 the only remaining Work to be performed is minor in nature and the remaining Work may reasonably be performed without having a material adverse effect on or materially interfering with the Owner's occupancy and use of the Project and
- .5 all prerequisites to Substantial Completion defined in the Contract Documents have been completed.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment together with the estimated value of completing or correcting such items (the "Punchlist") and (2) the permits and certificates referenced in Section 13.5. The Architect shall have the right to modify and supplement the Punchlist, including the estimated value of completion or correction.

Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor by the Architect. The certificate shall state the date of substantial completion, shall state any consequent responsibilities of the

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Contractor and the Owner in accordance with the Contract Documents. The Contractor shall complete and correct any incomplete and defective work within the number of calendar days stipulated in these Contract Documents.

§ 9.8.6 Services provided by the Architect to conduct more than three (3) inspections of completed Work or any inspections beyond thirty (30) calendar days after the date of substantial completion of any portion of the Work as stated in the Agreement shall be paid by the Contractor to the Owner. The Owner may deduct the cost of such services and inspections from payments due the Contractor.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner has accepted in writing the responsibilities assigned to it and the Contractor for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. By Final Completion, the Contractor shall have completed its performance of all Punchlist items, completed all balancing of mechanical and other applicable systems and all seasonal system adjustments that are reasonably necessary to proper functioning of the completed Project, delivered to the Owner all operations and maintenance manuals and completed related training for such manuals, and delivered to the Owner all required warranties and guarantees.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If the Contractor fails to furnish such releases or waivers as the Owner reasonably requires to satisfy the Owner that there are no outstanding liens, the Owner may require the Contractor, as a condition of final payment and at the Contractor's expense, to furnish a bond satisfactory to the Owner to indemnify the Owner against any such liens.
(Paragraphs Deleted)

§ 9.10.3 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee for payment for Work performed and of all other claims of which the payee knew or should have known at the time of final payment, except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor;
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction; and
- .4 work or property of the Owner, its tenants, or other parties at or near the Project site with the Owner's permission.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18. Where the damage or loss presents an immediate danger to the public, the Owner, in its sole discretion and at the Contractor's expense, may promptly remedy such damage or loss without prior notice to the Contractor.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

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10.2.9 The Contractor shall provide and maintain in good operating condition suitable and adequate fire protection equipment and services, and shall comply with all reasonable recommendations regarding fire protection made by the representatives of the fire insurance company carrying insurance on the Work or by the local fire chief or fire marshal. The area within the site limits shall be kept orderly and clean, and all combustible rubbish shall be promptly removed from the site.

10.2.10 The Contractor shall at all times protect excavations, trenches, buildings and materials from rain water, groundwater, backup or leakage of sewers, drains and other piping, and from water of any other origin and shall remove promptly any accumulation of water. The Contractor shall provide and operate all pumps, piping and other equipment necessary to this end.

10.2.11 The Contractor shall remove snow and ice which might result in damage or delay.

10.2.12 During the progress of the Work and at all times prior to the date of Substantial Completion or occupancy of the Work by the Owner, whichever is earlier, the Contractor shall provide temporary heat, ventilation, and enclosure, adequate to permit the Work to proceed in a timely fashion, and to prevent damage to completed Work or Work in progress, or to materials stored on the premises. The use of the permanent heating and/or ventilation systems for temporary heat and/or ventilation shall be subject to the prior written approval of the Owner and Architect.

10.2.13 The Contractor shall install weather protection and furnish adequate heat in the protected area from November 1 to March 31 as necessary.

§ 10.3 Hazardous Materials and Substances

10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. The Contractor shall not cause or permit any introduction onto, under, or near the Owner's property of any hazardous materials or substances as defined by any applicable law, and shall not cause or permit any release, discharge, transportation, storage, or disposal of such materials or substances onto, under, or near the Owner's property or areas near the Owner's property. If the Contractor encounters or recognizes on the site any material known or reasonably believed to be hazardous, including but not limited to asbestos or polychlorinated biphenyl (PCB), the Contractor shall immediately stop Work in the area affected and report the condition to the Owner and Architect in writing. The Contractor and the Owner shall cooperate in implementing measures to remove or contain said material and the Contractor shall comply with all directions of the Architect in the implementation of such removal or containment.

10.3.2 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Article 10 or for any violation of applicable law related to the Contractor's noncompliance with the provisions of this Article 10.

10.3.3 The parties anticipate that certain hazardous substances and/or materials may be discovered at the site. When such conditions are set forth in the Contract Documents, the Contractor acknowledges that such conditions have been considered in establishing the Contract Time and Contract Sum. No extension of the Contract Time or increase in the Contract Sum shall be claimed or allowed with respect to any hazardous substances or materials located at the site which were disclosed in the Contract Documents. The Contractor shall strictly comply with all laws, regulations, rules, orders, ordinances and the like related to the excavation, storage, removal and disposal of any such hazardous substances or materials.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

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ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract

and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- .1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- .2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- .3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- .4 Claims for damages insured by usual personal injury liability coverage;
- .5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- .6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- .7 Claims for bodily injury or property damage arising out of completed operations; and
- .8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall include all major divisions of coverage, and shall be on a comprehensive general basis including Premises and Operations (including X-C-U), Owner's and Contractor's Protective, Products and Completed Operations, and Owned, Non-owned, and Hired Motor Vehicles. Such insurance shall be written for not less than any limits of liability required by law or those set forth in the Contract Documents, whichever is greater.

(Paragraph Deleted)

All insurance shall be written on an occurrence basis, unless the Owner approves in writing coverage on a claims-made basis. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until date of final payment and any further period during which coverage is required to be maintained after final payment by the Contract Documents. The Owner shall be named an Additional Insured on all policies.

Coverage for such liability insurance shall be provided by a company or companies reasonably acceptable to the Owner and authorized to do business in the state the project is located. Contractor shall furnish to Owner written confirmation as to the insurance carrier's most current financial ratings prior to commencing work.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

These certificates shall set forth evidence of all coverage required by Sections 11.1.1 and 11.1.2. The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending limits of coverage.

§ 11.1.3.1 The Contractor shall be responsible for having acceptable insurance coverage provided by or on behalf of all Subcontractors, with such insurance to be similar to that required of the Contractor under the Agreement and these General Conditions. The Contractor shall not allow any Subcontractor to commence Work on the Project prior to the Contractor's receipt of certificates of insurance that are acceptable in form and limits to the Owner; the Owner shall have no obligation to pay the Contractor for any Work performed by a Subcontractor who has not supplied acceptable insurance certificates prior to starting its Work. The Owner shall be named an additional insured on all such certificates.

§ 11.1.3.2 All insurance policies shall contain provisions or endorsements necessary to assure coverage of claims by one insured against another. All required insurance policies are to be endorsed to state that the Contractor's policies shall be primary to all other insurance available to the Owner and other specified additional insureds for liability arising out of or resulting from the Contractor's operations under the Contract, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Owner's Project Manager, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.1.5 In no case shall the limits of liability be less than the following:

.1 General Liability of at least \$1,000,000 Bodily Injury and Property Damage Liability, Combined Single Limit with a \$3,000,000 Annual Aggregate Limit. Products and Completed Operations is to be maintained for up to 3 years after the completion of the project.

.2 Automobile Liability (applicable for any contractor who has an automobile operating exposure) of at least \$1,000,000 Bodily Injury and Property Damage per accident.

.3 Workers' Compensation Insurance as required by law.

.4 Property Coverage for materials and supplies being transported by the contractor, as the City's Property Contract provides coverage for personal property within 1000 feet of the premises.

.6 Umbrella Liability of at least \$2,000,000/ occurrence, \$2,000,000/aggregate.

§ 11.2 OWNER'S LIABILITY INSURANCE The Contractor shall procure and pay for an Owner's policy of Owner's protective liability insurance insuring the Owner and its officers, employees and agents against claims which may arise from operations under the Contract or relating thereto.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 The Contractor shall purchase and maintain property insurance upon the entire Work at the site to the full insurable value thereof. Coverage for such liability insurance shall be provided by a company or companies reasonably acceptable to the Owner. Contractor shall furnish to Owner written confirmation as to the insurance carrier's most current financial ratings prior to commencing work. Such insurance shall include the interests of the Owner, the

Contractor, Subcontractors and Sub-subcontractors in the work and shall insure against the perils of fire and extended coverage and shall include "all risks" insurance for physical loss or damage including without duplication, theft, vandalism and malicious mischief. This insurance shall also cover portions of the Work stored off the site or in transit. If this insurance is written with stipulated amounts deductible, the Owner shall not be responsible for any difference between the payments made by the insurance carrier and the claim. The

policy shall contain a provision that coverages afforded under policies will not be canceled or allowed to expire until at least 30 days' written notice has been given to the Owner. The Owner shall be named insured within the policy.

§ 11.3.2 The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.3 The Owner shall have the power to adjust and settle with its insurers any loss for which it has obtained insurance.

Upon the occurrence of an insured loss, the Owner and the Contractor shall cooperate with each other and with each other's insurer in the submission of claims and related information and the distribution of any insurance proceeds. If after such a loss no other special agreement is made, replacement of damaged work shall be covered by an appropriate change order.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder, each in the amount of 100% of the Contract Price, and each by a surety company qualified to do business under the laws of the State of Rhode Island and acceptable to the Owner. The attorney-in-fact who signs the bonds on behalf of the surety, must affix to each bond a certified and current copy of the power of attorney. The Performance and Payment Bonds shall be written in a form satisfactory to the Owner.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense. The Contractor shall bear the cost of any loss or damages to the Owner resulting from such failure or defect.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, 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 notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. 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 Section 2.5. If the correction or repair of any of the Work is required to avoid impacts to the maintenance, operation or safety of any

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portion of the Project site or the Owner's property, the Owner reserves the right to undertake the repairs prior to notifying the Contractor or without waiting for the Contractor to respond, without waiving the Owner's rights under the warranties and the Owner's right to correct work under Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the laws of the State of Rhode Island. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

(Paragraph Deleted)

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 The Contractor shall obtain and deliver promptly to the Architect any occupancy permit and any certificates of final inspection of any part of the Contractor's work and operating permits for any mechanical apparatus, such as elevators, escalators, boilers, air compressors, etc., which may be required by law to permit full use and occupancy of the premises by the Owner. Receipt of such permits or certificates by the Architect shall be a condition precedent to Substantial Completion of the Work.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.6 It is expressly agreed that the obligations of the Contractor hereunder arise out of contractual duties, and that the failure of the Contractor to comply with the requirements of the Contract Documents shall constitute a breach of contract, not a tort, for the purpose of applicable statutes of limitation and repose. Any cause of action which the Owner may have on account of such failure shall be deemed to accrue only when the Owner has obtained actual knowledge of such failure, not before.

§ 13.7 LIMITATION OF LIABILITY

§ 13.7.1 The Owner shall be liable, if ever, only to the extent of its interest in the Project; and no officer, director, partner, agent or employee of the Owner shall ever be personally or individually liable with respect to this Contract or the Work. Each Subcontract shall include the foregoing limitation, which shall be effective if the Owner ever succeeds to the Contractor's rights and obligations under a Subcontract.

§ 13.8 DEFENSE OF SUITS

§ 13.8.1 The Contractor shall be responsible for, shall defend and pay all costs, attorneys' fees and liabilities both direct and indirect as a result of suits arising out of this Contract.

§ 13.8.2 Neither final acceptance nor occupation of the premises by the Owner shall relieve the Contractor of responsibility for all claims for labor, materials, and equipment arising out of this Contract.

§ 13.8.3 The Contractor shall indemnify and hold harmless the Owner and the Architect and their agents and employees from and against all claims, damages, losses, and expenses including attorneys' fees arising out of or resulting from the performance of the work.

§ 13.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS

§ 13.9.1 The Contractor shall maintain policies of employment as follows:

§ 13.9.1.1 The Contractor and the Contractor's Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layout or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

§ 13.9.1.2 The Contractor and the Contractor's Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex or national origin.

§ 13.9.1.3 The Contractor shall be a signatory to the requirements of the Rhode Island Equal Employment Office.

§ 13.10 PREVAILING WAGES SCALES ON PUBLIC WORKS PROJECTS

§ 13.10.1. In accordance with Chapter 290 of the General laws of Rhode Island, 1938, as amended, the Department of Labor determined the customary and prevailing rate of wages paid to craftspersons, teamsters, and laborers in the constructing of public works by the State, and by cities and towns, and by persons contracting therewith for such construction. Violators are subject to a fine of not more than One Hundred Dollars (\$100.00) for each offense.

§ 13.10.2 The wage rates as ascertained by the Department of Labor are uniform for the State of Rhode Island and as of the date of advertisement of Contract applying to the life of this Contract. Information concerning wage rates prevailing in the construction industry in Rhode Island may be obtained from the Division of Professional Regulation, Department of Labor and Training, 1511 Pontiac Avenue, Cranston, Rhode Island, 02920 or their website www.dlt.state.ri.us.

Under no condition shall the wages paid to be less than those designated in the general classification. This clause does not relieve the Contractor or his Subcontractors from respecting any other union regulations to which he ordinarily subscribes.

§ 13.10.3 Bulletin No. 3, State Labor Laws, issued by the Rhode Island Department of Labor, pertaining to Public Works Projects (General Laws of Rhode Island, Revision of 1956, Chapter 37-12 as amended, and Chapter 77, Public Laws of 1965), is hereby made as part of this Project. These laws include, but are not limited to:

1. weekly payment of employees;
2. provisions applicable to public works contracts;
3. payment of prevailing wage rates;
4. posting of prevailing wage rates; and
5. overtime compensation.

§ 13.11 MINORITY BUSINESS REQUIREMENTS

It is the policy of the Owner to support the fullest possible participation of firms owned and controlled by minorities (MBEs) and women (WBEs).

See additional information and instructions in the preceding documents of this Project Manual.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 Provided that the Contractor is not in breach of any of its obligations under the Contract, the Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the

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Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work
(Paragraph Deleted)

because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents.

(Paragraph Deleted)

§ 14.1.2 Not Used

§ 14.1.3 If one of the above reasons exists, the Contractor may, upon seven days written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work properly executed and for all materials or equipment not incorporated in the Work, but delivered and suitably stored at the site. The payment for materials or equipment stored at the site shall be conditioned upon submission by the Contractor of bills of sale or such other evidence as is satisfactory to the Owner to establish the Owner's title to such material or equipment or otherwise protect the Owner's interest.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority;
- .4 becomes the subject of a voluntary petition in bankruptcy or any voluntary proceeding related to insolvency, receivership, liquidation or comparable proceeding or any assignment for the benefit of creditors or becomes the subject of an involuntary petition in bankruptcy or any involuntary proceeding related to insolvency, receivership, liquidation or comparable proceeding or any assignment for the benefit of creditors;
- .5 submits three successive Applications for Payment, each of which indicate that the actual Work completed is less than 90 percent of the values estimated in the construction schedule (submitted by the Contractor pursuant to Section 3.10.1) to be completed by the respective dates; or
- .6 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including all costs and losses incurred by the Owner on account of the Contractor's failure to comply with the Contract Documents and compensation for the Architect's and Owner's Project Manager's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The Owner shall be entitled to hold all amounts due the Contractor at the date of termination until all of the Owner's damages have been established, and to apply such amounts to such damages.

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§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1, subject to compliance with the conditions of Section 8.3. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In the event that the Contract is terminated for the Owner's convenience, the Contractor shall be reimbursed in accordance with the Contract Documents for all Work properly performed up to the termination date, and for all materials or equipment not incorporated in the Work, but delivered and suitably stored at the site.

Payment for materials or equipment stored at the site shall be conditioned upon submission by the Contractor of bills of sale or such other evidence as is satisfactory to the Owner to establish the Owner's title to such material or equipment or otherwise protect the Owner's interest. The Contractor shall not be entitled to payment for overhead and profit on the Work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

The word "Claim" shall mean a written demand by the Contractor for an increase in the Contract Time or the Contract Sum. The Contractor is responsible for substantiating its Claims. The word "Claim" shall not include claims by the Owner. The Owner may withhold from the
(Paragraph Deleted)

Contractor the value of any claims against the Contractor.

§ 15.1.2 Notice of Claims

Contractor must initiate Claims within fourteen (14) calendar days after occurrence of the event giving rise to such Claim by written notice to the Architect and the Owner. Such written notice must (1) be signed by the Contractor; (2) conspicuously identify on its face that the notice serves as a notice of claim; (3) explain in sufficient detail the basis of the Claim; (4) identify the date of the event giving rise to such Claim; and (5) state the exact dollar amount of the increase in the Contract Sum being requested, if any, and the number of days extension to the Contract Time sought, if any.

§ 15.1.3 Not Used

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

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§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a

response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be

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made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

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DOCUMENT 00 73 46

PREVAILING WAGE RATES

The State of Rhode Island Department of Labor, Division of Professional Regulation General Decision Modification document, current as of the bid issuance date for this Project, is an integral part of the Bid Documents for use in fulfilling prevailing wage rate requirements. A copy is included following this page.

Additional information concerning prevailing wage rates may be obtained from the Rhode Island Division of Professional Regulation, Department of Labor and Training, 1511 Pontiac Avenue, Cranston, Rhode Island, 02920.

"General Decision Number: RI20220001 02/25/2022

Superseded General Decision Number: RI20210001

State: Rhode Island

Construction Types: Building, Heavy (Heavy and Marine) and Highway

Counties: Rhode Island Statewide.

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories) HEAVY, HIGHWAY AND MARINE CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$15.00 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours
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	spent performing on the contract in 2022.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	<ul style="list-style-type: none"> . Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$11.25 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Modification Number	Publication Date
0	01/07/2022
1	01/21/2022
2	02/18/2022
3	02/25/2022

ASBE0006-006 12/01/2019

	Rates	Fringes
HAZARDOUS MATERIAL HANDLER (Includes preparation, wetting, stripping, removal scrapping, vacuuming, bagging & disposing of all insulation materials, whether they contain asbestos or not, from mechanical systems).....	\$ 36.60	22.40

ASBE0006-008 09/01/2021

Rates	Fringes
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Asbestos Worker/Insulator

Includes application of
all insulating materials,
protective coverings,
coatings & finishes to all
types of mechanical systems.

\$ 45.00

32.89

BOIL0029-001 01/01/2021

Rates

Fringes

BOILERMAKER.....\$ 45.87

29.02

BRRI0003-001 06/01/2020

Rates

Fringes

Bricklayer, Stonemason,
Pointer, Caulker & Cleaner.....\$ 42.55

28.02

BRRI0003-002 03/01/2020

Rates

Fringes

Marble Setter, Terrazzo
Worker & Tile Setter.....\$ 40.78

28.92

BRRI0003-003 03/01/2020

Rates

Fringes

Marble, Tile & Terrazzo
Finisher.....\$ 34.10

27.88

CARP0330-001 01/01/2021

Rates

Fringes

CARPENTER (Includes Soft

Floor Layer).....\$ 39.72

28.66

Diver Tender.....\$ 40.72

28.66

DIVER.....\$ 51.47

28.66

Piledriver.....\$ 39.72

28.66

WELDER.....\$ 40.72

28.66

FOOTNOTES:

When not diving or tending the diver, the diver and diver
tender shall receive the piledriver rate. Diver tenders

shall receive \$1.00 per hour above the pile driver rate when tending the diver.

Work on free-standing stacks, concrete silos & public utility electrical power houses, which are over 35 ft. in height when constructed: \$.50 per hour additional.

Work on exterior concrete shear wall gang forms, 45 ft. or more above ground elevation or on setback: \$.50 per hour additional.

The designated piledriver, known as the "monkey": \$1.00 per hour additional.

CARP1121-002 01/06/2020

	Rates	Fringes
MILLWRIGHT.....	\$ 39.07	29.15

ELEC0099-002 06/02/2021

	Rates	Fringes
ELECTRICIAN.....	\$ 43.61	54.71%
Teledata System Installer.....	\$ 32.71	12.57%+14.93

FOOTNOTES:

Work of a hazardous nature, or where the work height is 30 ft. or more from the floor, except when working OSHA-approved lifts: 20% per hour additional.

Work in tunnels below ground level in combined sewer outfall: 20% per hour additional.

ELEV0039-001 01/01/2022

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 56.91	36.885+a+b

FOOTNOTES:

A. PAID HOLIDAYS: New Years Day; Memorial Day; Independence Day; Labor Day; Veterans' Day; Thanksgiving Day; the Friday after Thanksgiving Day; and Christmas Day.

B. Employer contributes 8% basic hourly rate for 5 years or more of service of 6% basic hourly rate for 6 months to 5 years of service as vacation pay credit.

ENGI0057-001 12/01/2021

	Rates	Fringes
Operating Engineer: (power plants, sewer treatment plants, pumping stations, tunnels, caissons, piers, docks, bridges, wind turbines, subterranean & other marine and heavy construction work)		
GROUP 1.....	\$ 43.55	28.25+a
GROUP 2.....	\$ 41.55	28.25+a
GROUP 3.....	\$ 37.17	28.25+a
GROUP 4.....	\$ 34.32	28.25+a
GROUP 5.....	\$ 40.60	28.25+a
GROUP 6.....	\$ 31.40	28.25+a
GROUP 7.....	\$ 25.40	28.25+a
GROUP 8.....	\$ 37.25	28.25+a
GROUP 9.....	\$ 41.17	28.25+a

a. BOOM LENGTHS, INCLUDING JIBS:

150 feet and over + \$ 2.00
180 feet and over + \$ 3.00
210 feet and over + \$ 4.00
240 feet and over + \$ 5.00
270 feet and over + \$ 7.00
300 feet and over + \$ 8.00
350 feet and over + \$ 9.00
400 feet and over + \$10.00

a. PAID HOLIDAYS:

New Year's Day, President's Day, Memorial Day, July Fourth, Victory Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day, Christmas Day. a: Any employee who works 3 days in the week in which a holiday falls shall be paid for the holiday.

a. FOOTNOTES:

Hazmat work: \$2.00 per hour additional.
Tunnel/Shaft work: \$5.00 per hour additional.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, lighters, boom trucks and derricks

GROUP 2: Digging machine, Ross Carrier, locomotive, hoist, elevator, bidwell-type machine, shot & water blasting machine, paver, spreader, graders, front end loader (3 yds. and over), vibratory hammer & vacuum truck, roadheaders, forklifts, econobile type equipment, tunnel boring machines, concrete pump and on site concrete plants.

GROUP 3: Oilers on cranes.

GROUP 4: Oiler on crawler backhoe.

GROUP 5: Bulldozer, bobcats, skid steer loader, tractor, scraper, combination loader backhoe, roller, front end loader (less than 3 yds.), street and mobile-powered sweeper (3-yd. capacity), 8-ft. sweeper minimum 65 HP).

GROUP 6: Well-point installation crew.

GROUP 7: Utility Engineers and Signal Persons

GROUP 8: Heater, concrete mixer, stone crusher, welding machine, generator and light plant, gas and electric driven pump and air compressor.

GROUP 9: Boat & tug operator.

ENGI0057-002 11/01/2021

	Rates	Fringes
Power Equipment Operator (highway construction projects; water and sewerline projects which are incidental to highway construction projects; and bridge projects that do not span water)		
GROUP 1.....	\$ 36.70	28.25+a
GROUP 2.....	\$ 31.40	28.25+a
GROUP 3.....	\$ 25.40	28.25+a
GROUP 4.....	\$ 31.98	28.25+a
GROUP 5.....	\$ 35.68	28.25+a
GROUP 6.....	\$ 35.30	28.25+a
GROUP 7.....	\$ 30.95	28.25+a
GROUP 8.....	\$ 32.33	28.25+a

GROUP 9.....\$ 34.28 28.25+a

a. FOOTNOTE: a. Any employee who works three days in the week in which a holiday falls shall be paid for the holiday.

a. PAID HOLIDAYS: New Year's Day, President's Day, Memorial Day, July Fourth, Victory Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day & Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Digging machine, crane, piledriver, lighter, locomotive, derrick, hoist, boom truck, John Henry's, directional drilling machine, cold planer, reclaimer, paver, spreader, grader, front end loader (3 yds. and over), vacuum truck, test boring machine operator, veemere saw, water blaster, hydro-demolition robot, forklift, economobile, Ross Carrier, concrete pump operator and boats

GROUP 2: Well point installation crew

GROUP 3: Utility engineers and signal persons

GROUP 4: Oiler on cranes

GROUP 5: Combination loader backhoe, front end loader (less than 3 yds.), forklift, bulldozers & scrapers and boats

GROUP 6: Roller, skid steer loaders, street sweeper

GROUP 7: Gas and electric drive heater, concrete mixer, light plant, welding machine, pump & compressor

GROUP 8: Stone crusher

GROUP 9: Mechanic & welder

ENGI0057-003 12/01/2021

BUILDING CONSTRUCTION

	Rates	Fringes
Power Equipment Operator		
GROUP 1.....	\$ 42.82	28.25+a
GROUP 2.....	\$ 40.82	28.25+a
GROUP 3.....	\$ 40.60	28.25+a
GROUP 4.....	\$ 36.60	28.25+a
GROUP 5.....	\$ 33.75	28.25+a

GROUP 6.....	\$ 39.90	28.25+a
GROUP 7.....	\$ 39.47	28.25+a
GROUP 8.....	\$ 36.79	28.25+a

a. BOOM LENGTHS, INCLUDING JIBS:

150 ft. and over: + \$ 2.00
180 ft. and over: + \$ 3.00
210 ft. and over: + \$ 4.00
240 ft. and over: + \$ 5.00
270 ft. and over: + \$ 7.00
300 ft. and over: + \$ 8.00
350 ft. and over: + \$ 9.00
400 ft. and over: + \$10.00

a. PAID HOLIDAYS: New Year's Day, President's Day, Memorial Day, July Fourth, Victory Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day & Christmas Day. a: Any employee who works 3 days in the week in which a holiday falls shall be paid for the holiday.

a. FOOTNOTE: Hazmat work: \$2.00 per hour additional.
Tunnel/Shaft work: \$5.00 per hour additional.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, lighters, boom trucks and derricks.

GROUP 2: Digging machine, Ross carrier, locomotive, hoist, elevator, bidwell-type machine, shot & water blasting machine, paver, spreader, front end loader (3 yds. and over), vibratory hammer and vacuum truck

GROUP 3: Telehandler equipment, forklift, concrete pump & on-site concrete plant

GROUP 4: Fireman & oiler on cranes

GROUP 5: Oiler on crawler backhoe

GROUP 6: Bulldozer, skid steer loaders, bobcats, tractor, grader, scraper, combination loader backhoe, roller, front end loader (less than 3 yds.), street and mobile powered sweeper (3 yds. capacity), 8-ft. sweeper (minimum 65 hp)

GROUP 7: Well point installation crew

GROUP 8: Heater, concrete mixer, stone crusher, welding machine, generator for light plant, gas and electric driven pump & air compressor

IRON0037-001 09/16/2021

	Rates	Fringes
IRONWORKER.....	\$ 38.21	30.58

LABO0271-001 05/30/2021

BUILDING CONSTRUCTION

	Rates	Fringes
LABORER		
GROUP 1.....	\$ 33.55	26.15
GROUP 2.....	\$ 33.80	26.15
GROUP 3.....	\$ 34.30	26.15
GROUP 4.....	\$ 34.55	26.15
GROUP 5.....	\$ 35.55	26.15

LABORERS CLASSIFICATIONS

GROUP 1: Laborer, Carpenter Tender, Mason Tender, Cement Finisher Tender, Scaffold Erector, Wrecking Laborer, Asbestos Removal [Non-Mechanical Systems]

GROUP 2: Asphalt Raker, Adzemen, Pipe Trench Bracer, Demolition Burner, Chain Saw Operator, Fence & Guard Rail Erector, Setter of Metal Forms for Roadways, Mortar Mixer, Pipelayer, Riprap & Dry Stonewall Builder, Highway Stone Spreader, Pneumatic Tool Operator, Wagon Drill Operator, Tree Trimmer, Barco-Type Jumping Tamper, Mechanical Grinder Operator

GROUP 3: Pre-Cast Floor & Roof Plank Erectors

GROUP 4: Air Track Operator, Hydraulic & Similar Self-Powered Drill, Block Paver, Rammer, Curb Setter, Powderman & Blaster

GROUP 5: Toxic Waste Remover

LABO0271-002 05/30/2021

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
LABORER		

COMPRESSED AIR		
Group 1.....	\$ 53.45	24.15
Group 2.....	\$ 50.98	24.15
Group 3.....	\$ 40.50	24.15
FREE AIR		
Group 1.....	\$ 44.05	24.15
Group 2.....	\$ 43.05	24.15
Group 3.....	\$ 40.50	24.15
LABORER		
Group 1.....	\$ 33.55	24.15
Group 2.....	\$ 33.80	24.15
Group 3.....	\$ 34.55	24.15
Group 4.....	\$ 27.05	24.15
Group 5.....	\$ 35.55	24.15
OPEN AIR CAISSON, UNDERPINNING WORK AND BORING CREW		
Bottom Man.....	\$ 39.55	24.15
Top Man & Laborer.....	\$ 38.60	24.15
TEST BORING		
Driller.....	\$ 40.00	24.15
Laborer.....	\$ 38.60	24.15

LABORER CLASSIFICATIONS

GROUP 1: Laborer; Carpenter tender; Cement finisher tender; Wrecking laborer; Asbestos removers [non-mechanical systems]; Plant laborer; Driller in quarries

GROUP 2: Adzeperson; Asphalt raker; Barcotype jumping tamper; Chain saw operators; Concrete and power buggy operator; Concrete saw operator; Demolition burner; Fence and guard rail erector; Highway stone spreader; Laser beam operator; Mechanical grinder operator; Mason tender; Mortar mixer; Pneumatic tool operator; Riprap and dry stonewall builder; Scaffold erector; Setter of metal forms for roadways; Wagon drill operator; Wood chipper operator; Pipelayer; Pipe trench bracer

GROUP 3: Air track drill operator; Hydraulic and similar powered drills; Brick paver; Block paver; Rammer and curb setter; Powderperson and blaster

GROUP 4: Flagger & signaler

GROUP 5: Toxic waste remover

LABORER - COMPRESSED AIR CLASSIFICATIONS

GROUP 1: Mucking machine operator, tunnel laborer, brake

person, track person, miner, grout person, lock tender,
gauge tender, miner: motor person & all others in
compressed air

GROUP 2: Change house attendant, powder watchperson, top
person on iron

GROUP 3: Hazardous waste work within the "HOT" zone

LABORER - FREE AIR CLASSIFICATIONS

GROUP 1: Grout person - pumps, brake person, track person,
form mover & stripper (wood & steel), shaft laborer,
laborer topside, outside motorperson, miner, conveyor
operator, miner welder, heading motorperson, erecting
operator, mucking machine operator, nozzle person,
rodperson, safety miner, shaft & tunnel, steel & rodperson,
mole nipper, concrete worker, form erector (wood, steel and
all accessories), cement finisher (this type of work only),
top signal person, bottom person (when heading is 50' from
shaft), burner, shield operator and TBM operator

GROUP 2: Change house attendant, powder watchperson

GROUP 3: Hazardous waste work within the "HOT" zone

PAIN0011-005 06/01/2021

	Rates	Fringes
PAINTER		
Brush and Roller.....	\$ 36.42	22.90
Epoxy, Tanks, Towers, Swing Stage & Structural Steel.....	\$ 38.42	22.90
Spray, Sand & Water Blasting.....	\$ 39.42	22.90
Taper.....	\$ 37.17	22.90
Wall Coverer.....	\$ 36.92	22.90

PAIN0011-006 06/01/2021

	Rates	Fringes
GLAZIER.....	\$ 39.98	22.90

FOOTNOTES:

SWING STAGE: \$1.00 per hour additional.

PAID HOLIDAYS: Labor Day & Christmas Day.

PAIN0011-011 06/01/2021

	Rates	Fringes
Painter (Bridge Work).....	\$ 54.00	22.90

PAIN0035-008 06/01/2011

	Rates	Fringes
Sign Painter.....	\$ 24.79	13.72

PLAS0040-001 06/03/2019

BUILDING CONSTRUCTION

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 36.00	27.15

FOOTNOTE: Cement Mason: Work on free swinging scaffolds under
3 planks width and which is 20 or more feet above ground
and any offset structure: \$.30 per hour additional.

PLAS0040-002 07/01/2019

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 32.85	22.20

PLAS0040-003 07/01/2019

	Rates	Fringes
PLASTERER.....	\$ 37.55	27.50

PLUM0051-002 08/30/2021

	Rates	Fringes
Plumbers and Pipefitters.....	\$ 46.49	31.40

ROOF0033-004 12/01/2021

	Rates	Fringes
ROOFER.....	\$ 40.40	29.06

 SFRI0669-001 01/01/2022

	Rates	Fringes
SPRINKLER FITTER.....	\$ 47.55	27.14

 SHEE0017-002 12/01/2020

	Rates	Fringes
Sheet Metal Worker.....	\$ 38.58	36.73

 TEAM0251-001 05/01/2019

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
TRUCK DRIVER		
GROUP 1.....	\$ 27.96	26.8525+A+B+C
GROUP 2.....	\$ 27.61	26.8525+A+B+C
GROUP 3.....	\$ 27.66	26.8525+A+B+C
GROUP 4.....	\$ 27.71	26.8525+A+B+C
GROUP 5.....	\$ 27.81	26.8525+A+B+C
GROUP 6.....	\$ 28.21	26.8525+A+B+C
GROUP 7.....	\$ 28.41	26.8525+A+B+C
GROUP 8.....	\$ 27.91	26.8525+A+B+C
GROUP 9.....	\$ 28.16	26.8525+A+B+C
GROUP 10.....	\$ 27.96	26.8525+A+B+C

FOOTNOTES:

A. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day, plus Presidents' Day, Columbus Day, Veteran's Day & V-J Day, providing the employee has worked at least one day in the calendar week in which the holiday falls.

B. Employee who has been on the payroll for 1 year or more but less than 5 years and has worked 150 Days during the last year of employment shall receive 1 week's paid vacation; 5 to 10 years - 2 weeks' paid vacation; 10 or more years - 3 week's paid vacation.

C. Employees on the seniority list shall be paid a one

hundred dollar (\$100.00) bonus for every four hundred (400) hours worked, up to a maximum of five hundred dollars (\$500.00)

All drivers working on a defined hazard material job site shall be paid a premium of \$2.00 per hour over applicable rate.

TRUCK DRIVER CLASSIFICATIONS

GROUP 1: Pick-up trucks, station wagons, & panel trucks

GROUP 2: Two-axle on low beds

GROUP 3: Two-axle dump truck

GROUP 4: Three-axle dump truck

GROUP 5: Four- and five-axle equipment

GROUP 6: Low-bed or boom trailer.

GROUP 7: Trailers when used on a double hook up (pulling 2 trailers)

GROUP 8: Special earth-moving equipment, under 35 tons

GROUP 9: Special earth-moving equipment, 35 tons or over

GROUP 10: Tractor trailer

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons

resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all

rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

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SECTION 01 10 00

SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Contract description.
- B. Contractor's use of site and premises.
- C. Work sequence.
- D. Owner occupancy.
- E. Hazardous Material Suspicion
- F. Definitions
- G. Covid-19 Safety and Health Protocol

1.02 CONTRACT DESCRIPTION

- A. Work of the Project includes the upgrading of the HVAC system at the Roger Williams Park Natural History Museum as described on the drawings and in this project manual.
- B. Perform the Work of the Contract under a stipulated sum Contract with the Owner in accordance with the Conditions of Contract.
- C. The Work of the Contract is identified in the Project Manual and on the Drawings.

1.03 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limit use of the site and premises to allow:
 - 1. Owner occupancy throughout construction.
 - 2. Use of the site and premises by the public.
- B. Construction Personnel Conduct
 - 1. The following conduct by construction personnel will not be tolerated on the Owner's property, violators may be ejected from the site.
 - a. NO SMOKING is allowed. The Contractor will erect signs noting such at all entrances.
 - b. No drugs or alcohol are allowed
 - c. No firearms or weapons are allowed.
 - d. No foul language will be tolerated.
 - e. No fighting. All involved will be subject to being removed from the site.

C. On-Site Work Hours:

1. Work shall be generally performed during normal business working hours of 7:00 A.M. to 3:30 P.M., Monday through Friday, except otherwise indicated.
2. Weekend Hours: 8:30 A.M. to 4:30 P.M. Saturday or Sunday with written permission from the Owner 48 hours in advance of the date requested.
3. All exceptionally noisy work is restricted to between 9 A.M. and 5 P.M.
4. Holiday Hours: No work shall be permitted on major holidays.
5. Hours for Utility Shutdowns: Utility shutdowns which may have an impact on the operation of the existing building shall not be allowed without prior written permission and approval from the Owner

1.04 WORK SEQUENCE

- A. Construct the Work to accommodate the Owner's occupancy requirements during the construction period between June 20, 2022, through September 31, 2022 at which time the facility will be closed to the public. Additionally, the contractor shall coordinate the construction schedule and operations with the Owner.

1.05 OWNER OCCUPANCY

- A. The Owner will occupy the site and premises during the entire period of construction.
- B. Cooperate with the Owner to minimize conflict, and to facilitate the Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.06 HAZARDOUS MATERIAL SUSPICION

- A. If, during the course of construction, the Contractor suspects a material to contain asbestos, all work involving the material is to be stopped and the Architect notified immediately of the suspicion. Until the material is confirmed to be safe or tested and determined to be an asbestos containing material, the Contractor is to assume it contains asbestos and is to avoid contact. Upon notification of its composition the Architect will determine the course of action and inform the Contractor accordingly.

1.07 DEFINITIONS

- A. Basic Contract definitions are included below.
1. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
 2. "Directed": A command or instruction by Architect. . Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
 3. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

4. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
5. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
6. "Install": Operations at Project site including unloading, temporarily storing, unpacking, disposing of packaging, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
7. "Provide": Furnish and install, complete, in place, and ready for the intended use.
8. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings.

1.08 COVID-19 SAFETY AND HEALTH PROTOCOL

- A. The Contractor and all employees working on-site are to follow the operating procedures in accordance with the current safety and health guidelines issued by the Centers for Disease Control and Prevention (CDC), OSHA, RI Department of Health, and local agencies for preventing the spread of the COVID-19 infection.

1.11 LICENSED CONTRACTOR NOTE

- A. Please note that this project requires that the General Contractor hire Mechanical and Electrical Sub-Contractors that are to be fully licensed with the State of Rhode Island to perform all work noted in the Contract documents.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

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SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Schedule of values.
- B. Applications for payment.
- C. Sales Tax Exemption
- D. Utility Company Charges
- E. Change procedures.
- F. Defect assessment.
- G. Unit prices.

1.02 SCHEDULE OF VALUES

- A. Submit a printed schedule on AIA Form G703 - Application and Certificate for Payment Continuation Sheet
- B. Submit Schedule of Values in duplicate, one copyrighted original and one copy, within fifteen (15) days after date of receipt of a Notice to Proceed.
- C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the major specification Section. Identify site mobilization, bonds and insurance.
- D. Include in each line item, the amount of Allowances specified in Section 01 21 00 if occurring. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- F. Revise schedule to list approved Change Orders, with each Application for Payment.

1.03 APPLICATIONS FOR PAYMENT

- A. Submit each application on an original copyrighted AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet, accompanied by three copies.
 - 1. Individually sign and notarize, and emboss with notary's official seal, the original and each of the three copies.
 - 2. Applications not including original copyrighted AIA G702, and G703 Forms, will be rejected, and returned for resubmittal.

3. Applications not properly signed and notarized will be rejected, and returned for resubmittal.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Provide one copy of the updated construction schedule with each Application for Payment submission.
 1. Provide a statement signed by the Contractor's firm principal certifying that there are no unidentified outstanding claims for delay.
- D. Include with each monthly Application for Payment, following the first application, one copy of the Certified Monthly Payroll Record for the previous month's pay period.
- E. Payment Period: Submit at intervals stipulated in the Agreement.
- F. Submit with transmittal letter as specified for Submittals in Section 01 33 00.
- G. Beginning with the second Application for Payment, Contractor's right to payment must be substantiated by documenting, on a copy of the Waiver of Lien Form included in Document 00 65 19.16 - Waiver of Lien Form in this Project Manual, that payment monies due, less retainage not exceeding ten percent, have been paid in full to subcontractor and suppliers for work, materials, or rental of equipment billed for under specific line item numbers in the immediately preceding application.
- H. Substantiating Data: When the Architect requires substantiating information, submit data justifying dollar amounts in question. Include the following with the Application for Payment :
 1. Record Documents as specified in Section 01 78 00, for review by the Owner which will be returned to the Contractor.
 2. Affidavits attesting to off-site stored products.
 3. Construction progress schedules, revised and current as specified in Section 01 33 00.

1.04 SALES TAX EXEMPTION

- A. Owner is exempt from sales tax on products permanently incorporated in Work of the Project.

1.05 UTILITY COMPANY CHARGES

- A. The Owner will pay for all Utility Company and Municipal back charges for all materials furnished and work performed by them in conjunction with this contract.

1.06 CHANGE PROCEDURES

- A. Submittals: Submit name of the individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. The Architect will advise of minor changes in the Work not involving an adjustment to Contract Sum or Contract Time by issuing supplemental instructions on AIA Form G710
- C. The Architect may issue a Proposal Request which includes a detailed description of a proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time

during which the requested price will be considered valid. Contractor will prepare and submit an estimate within fifteen (15) days.

- D. The Contractor may propose changes by submitting a request for change to the Architect, describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation, and a statement describing the effect on Work by separate or other Contractors. Document any requested substitutions in accordance with Section 01 60 00.
- E. Stipulated Sum Change Order: Based on Proposal Request, and Contractor's fixed price quotation, or Contractor's request for a Change Order as approved by Architect.
- F. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of work that are not pre-determined, execute the Work under a Construction Change Directive. Changes in the Contract Sum or Contract Time will be computed as specified for a Time and Material Change Order.
- G. Construction Change Directive: Architect may issue a directive, on AIA Form G713 Construction Change Directive signed by the Owner, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in the Contract Sum or Contract Time. Promptly execute the change.
- H. Time and Material Change Order: Submit an itemized account and supporting data after completion of the change, within the time limits indicated in the Conditions of the Contract. The Architect will determine the change allowable in the Contract Sum and Contract Time as provided in the Contract Documents.
- I. Maintain detailed records of work done on a Time and Material basis. Provide full information required for an evaluation of the proposed changes, and to substantiate costs for the changes in the Work.
- J. Document each quotation for a change in cost or time with sufficient data to allow an evaluation of the quotation. Provide detailed breakdown of costs and estimates for labor and materials including a detailed breakdown for subcontractor's or vendor's Work. Include copies of written quotations from subcontractors or vendors.
- K. Change Order Forms: AIA G701 Change Order.
- L. Execution of Change Orders: The Architect will issue Change Orders for signatures of the parties as provided in the Conditions of the Contract.
- M. Correlation Of Contractor Submittals:
 - 1. Promptly revise the Schedule of Values and the Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
 - 2. Promptly revise progress schedules to reflect any change in the Contract Time, revise sub-schedules to adjust times for any other items of work affected by the change, and resubmit.
 - 3. Promptly enter changes in the Project Record Documents.

1.07 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of the Architect, it is not practical to remove and replace the Work, the Architect will direct an appropriate remedy or adjust payment.
- C. The defective Work may remain, but the unit sum will be adjusted to a new sum at the discretion of the Architect.
- D. The defective Work will be partially repaired to the instructions of the Architect, and the unit sum will be adjusted to a new sum at the discretion of the Architect.
- E. The individual Specification Sections may modify these options or may identify a specific formula or percentage sum reduction.
- F. The authority of the Architect to assess the defect and identify a payment adjustment is final.
- G. Non-Payment for Rejected Products: Payment will not be made for rejected products for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected products.

1.08 UNIT PRICES

- A. Authority: Measurement methods are delineated in the individual specification Sections.
- B. Measurement methods delineated in the individual specification Sections complement the criteria of this section. In case of conflict, the requirements of the individual specification Section govern.
- C. Take measurements and compute quantities. The Architect will verify measurements and quantities.
- D. Unit Quantities: The quantities and measurements indicated in the Bid Form are for contract purposes only. The quantities and measurements supplied or placed in the Work shall determine payment.
 - 1. When the actual Work requires more or fewer quantities than those quantities indicated, provide the required quantities at the unit sum contracted.
 - 2. When the actual Work requires a 25 percent or greater change in quantity than those quantities indicated, the Owner or Contractor may claim for a Contract Price adjustment.
- E. Unit Price amount includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.
- F. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the Architect multiplied by the unit sum for Work which is incorporated in or made necessary by the Work.

- G. Measurement of Quantities:
1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
 3. Metering Devices: Inspected, tested and certified by the applicable State department within the past year.
 4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
 5. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
 6. Measurement by Area: Measured by square dimension using mean length and width or radius.
 7. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
 8. Stipulated Sum Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

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SECTION 01 31 00

ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Coordination and project conditions.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Preinstallation meetings.

1.02 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate the scheduling, submittals, and the Work of the various Sections of the Project Manual to ensure an efficient and orderly sequence of the installation of interdependent construction elements with provisions for accommodating the items installed later.
- B. Verify that the utility requirements and characteristics of the operating equipment are compatible with the building utilities. Coordinate the Work of the various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate the space requirements, supports, and installation of the mechanical, plumbing and electrical Work, which are indicated diagrammatically on the Drawings. Follow the routing shown for the pipes, ducts, and conduit, as closely as practicable; place runs parallel with the lines of the building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
 - 1. The Contractor is to provide coordination drawings indicating size and locations of all mechanical, plumbing, fire protection and electrical work to confirm conflicts do not exist between systems. Submit four hard copies to the Architect for review prior to purchasing and fabrication of materials.
- D. In finished areas except as otherwise indicated, conceal the pipes, ducts, and wiring within the construction. Coordinate the locations of fixtures and outlets with the finish elements.
- E. Coordinate the completion and clean up of the Work of the separate Sections in preparation for Substantial Completion.
- F. After the Owner's occupancy of the premises, coordinate access to the site for correction of the defective Work and the Work not in accordance with the Contract Documents, to minimize disruption of the Owner's activities.

1.03 PRECONSTRUCTION MEETING

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

1.04 SITE MOBILIZATION MEETING

- A. The Architect will schedule a meeting at the Project site prior to the Contractor's occupancy.
- B. Attendance Required: The Owner, Architect, Special Consultants, and, Contractor, the Contractor's Superintendent, and major Subcontractors.
- C. Agenda:
 - 1. Use of the premises by the Owner and the Contractor.
 - 2. The Owner's requirements and occupancy.
 - 3. Construction facilities and controls provided by the Owner.
 - 4. Temporary utilities provided by the 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 the record documents.
 - 11. Requirements for start-up of the equipment.
 - 12. Inspection and acceptance of the equipment put into service during the construction period.
- D. Record the minutes and distribute the copies within two days after the meeting to the participants, with two copies to the Architect, Owner, participants, and those affected by the decisions made.

1.05 PROGRESS MEETINGS

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

1.06 PREINSTALLATION MEETING

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

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed products list.
- D. Method for Submission of Shop Drawings and Product Data
- E. Product data.
- F. Shop drawings.
- G. Samples.
- H. Design data.
- I. Test reports.
- J. Certificates.
- K. Manufacturer's instructions.
- L. Manufacturer's field reports.
- M. Erection drawings.

1.02 SUBMITTAL PROCEDURES

- A. Master List Submittal:
 - 1. Submit a master list of the required submittals with a proposed date for each item to be submitted.
 - 2. Show the date submittal was sent, days since submittal was sent, status of submittal, date submittal was received in return, and any date associated with resubmittals.
 - 3. Up date master list with each submission and response.
 - 4. Issue copy of master list at least monthly to the Architect.
- B. Transmit each submittal with a transmittal form.
- C. Sequentially number the transmittal form. Mark revised submittals with the original number and a sequential alphabetic suffix.

- D. Identify the Project, Contractor, subcontractor and supplier; the pertinent drawing and detail number, and the specification Section number, appropriate to the submittal.
- E. Apply a Contractor's stamp, signed or initialed, certifying that the review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of the information is in accordance with the requirements of the Work and the Contract Documents.
- F. Schedule submittals to expedite the Project, and deliver to the Architect at their business address. Coordinate the submission of related items. Upon completion of the submittal's review, the Architect's office will notify the Contractor. The Contractor is then responsible to pick-up the submittals in a timely manner.
- G. For each submittal for review, allow fifteen (15) calendar days excluding the delivery time to and from the Contractor.
- H. Identify the variations from the Contract Documents and the Product or system limitations that may be detrimental to a successful performance of the completed Work.
- I. Allow space on the submittals for the Contractor's and the Architect's review stamps.
- J. When revised for resubmission, identify the changes made since the previous submission.
- K. Distribute copies of the reviewed submittals as appropriate. Instruct the parties to promptly report an inability to comply with the Contract requirements.
- L. Submittals not requested will not be recognized or processed. The Contractor will be notified of the submittal's refusal.
- M. The Contractor will compensate the Architect and all consulting Engineers for services performed reviewing submittals beyond the original review and two follow-up reviews of the same product, material, sample or assembly. The compensation will be made through a credit change order that will reduce the total contract amount.

1.03 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit preliminary outline Schedules within fifteen (15) days after the date of receipt of a Notice to Proceed for coordination with the Owner's requirements. After a review, submit detailed schedules within fifteen (15) days modified to accommodate the revisions recommended by the Architect.
- B. Submit revised Progress Schedules with each Application for Payment.
- C. Distribute copies of the reviewed schedules to the Project site file, subcontractors, suppliers, and other concerned parties.
- D. Instruct the recipients to promptly report, in writing, the problems anticipated by the projections indicated in the schedules.
- E. Submit a computer generated horizontal bar chart with a separate line for each major portion of the Work or operation, or section of the Work, identifying the first workday of each week.

- F. Show a complete sequence of construction by activity, identifying the Work of separate stages and other logically grouped activities. Indicate the early and late start, the early and late finish, float dates, and the duration.
- G. Indicate an estimated percentage of completion for each item of the Work at each submission.
- H. Provide a separate schedule of submittal dates for shop drawings, product data, and samples, including Owner furnished Products and Products identified under Allowances, if any, and the dates reviewed submittals will be required from the Architect. Indicate the decision dates for selection of the finishes.
- I. Indicate the delivery dates for Owner furnished Products, and for Products identified under Allowances.
- J. Revisions to Schedules:
 - 1. Indicate the progress of each activity to the date of submittal, and the projected completion date of each activity.
 - 2. Identify the activities modified since the previous submittal, major changes in the scope, and other identifiable changes.
 - 3. Provide a narrative report to define the problem areas, the anticipated delays, and impact on the Schedule. Report the corrective action taken, or proposed, and its effect including the effect of changes on the schedules of separate contractors.

1.04 PROPOSED PRODUCTS LIST

- A. Within fifteen (15) days after the date of receipt of a Notice to Proceed, submit a list of major products proposed for use, with the name of the manufacturer, the trade name, and the model number of each product.
- B. For the products specified only by reference standards, give the manufacturer, trade name, model or catalog designation, and reference standards.
- C. With each product listed, indicate the submittal requirements specified to be adhered to, and an indication of relevant "long-lead-time" information, when appropriate.

1.05 METHOD FOR SUBMISSION OF SHOP DRAWING AND PRODUCT DATA

- A. Method of electronic or hard copy delivery of shop drawing and data submittals is to be discussed with Architect at Preconstruction meeting.
Use one of the three methods listed below:
 - 1. Use an internet-based system agreed upon by the Architect and Contractor.
Comply with required transmittal and data formats using numbering system approved by Architect.
Assemble submittal package into a single indexed file incorporating submittal and cover sheet explaining project name, number, Architect, Contractor and submittal number.
 - 2. Email an electronic format (PDF) copy to the Architect.
Comply with required transmittal and data formats using numbering system approved by Architect.
Assemble submittal package into a single indexed file incorporating submittal and cover sheet explaining project name, number, Architect, Contractor and submittal number.

3. Hard copies delivered to the Architect are to be submitted with the number of copies that the Contractor requires, plus three copies the Architect will retain.
- B. All shop drawings 24" x 36" or larger are to be delivered to the Architect in hard copy format as noted in Method 3 above.
- C. All submittals are to include a Contractor's review stamp confirming approval prior to submission to the Architect.
- D. The Architect will return the reviewed submittal to the Contractor for distribution to subcontractors, suppliers, fabricators, and others as necessary for proper performance of the Work.
- E. Submit color samples on actual product material for final color selection by sending them via postal or delivery service directly to the Architect's office.

1.06 PRODUCT DATA

- A. Product Data: Submit to the Architect for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Provide copies and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 78 00.
- B. Mark each copy to identify the applicable products, models, options, and other data. Supplement the manufacturers' standard data to provide the information specific to this Project.
- C. Indicate the product utility and electrical characteristics, the utility connection requirements, and the location of utility outlets for service for functional equipment and appliances.
- D. After receiving approved submittals, distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01 78 00.

1.07 SHOP DRAWINGS

- A. Shop Drawings: Submit to the Architect for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Produce copies and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 78 00.
- B. Indicate the special utility and electrical characteristics, the utility connection requirements, and the location of utility outlets for service for functional equipment and appliances.
- C. Submit according to method agreed upon in Paragraph 1.05 or if submitting hard copies, submit the number of copies that the Contractor requires, plus three copies the Architect will retain.

1.08 SAMPLES

- A. Samples: Submit to the Architect for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Produce duplicates and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 78 00.

- B. Samples For Selection as Specified in Product Sections:
 - 1. Submit to the Architect for aesthetic, color, or finish selection.
 - 2. Submit samples of the finishes, indicating colors, texture, and patterns for the Architect's selection.
 - 3. After review, produce duplicates and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 78 00.
- C. Submit samples to illustrate the functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate the sample submittals for interfacing Work.
- D. Include identification on each sample, with the full Project information.
- E. Submit the number of samples specified in the individual specification Sections; the Architect will retain one sample.
- F. Reviewed samples, which may be used in the Work, are indicated in the individual specification Sections.
- G. Samples will not be used for testing purposes unless they are specifically stated to be in the specification Section.

1.09 DESIGN DATA

- A. Submit for the Architect's knowledge as contract administrator.
- B. Submit for information for the limited purpose of assessing conformance with the information given and the design concept expressed in the Contract Documents.

1.10 TEST REPORTS

- A. Submit for the Architect's knowledge as contract administrator.
- B. Submit test reports for information for the limited purpose of assessing conformance with the information given and the design concept expressed in the Contract Documents.

1.11 CERTIFICATES

- A. When specified in the individual specification Sections, submit certification by the manufacturer, installation/application subcontractor, or the Contractor to the Architect, in the quantities specified for the Product Data.
- B. Indicate that the material or product conforms to or exceeds the specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on the material or product, but must be acceptable to the Architect.

1.12 MANUFACTURER'S INSTRUCTIONS

- A. When specified in the individual specification Sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to the Architect for delivery to the Owner in the quantities specified for Product Data.
- B. Indicate the special procedures, and the perimeter conditions requiring special attention, and the special environmental criteria required for application or installation.

1.13 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for the Architect's benefit as contract administrator.
- B. Submit the report in duplicate within thirty (30) days of observation to the Architect for information.
- C. Submit for information for the limited purpose of assessing conformance with the information given and the design concept expressed in the Contract Documents.

1.14 ERECTION DRAWINGS

- A. Submit drawings for the Architect's benefit as contract administrator.
- B. Submit for information for the limited purpose of assessing conformance with the information given and the design concept expressed in the Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by the Architect.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 43 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Quality control and control of installation.
- B. Verification of Credentials and Licenses.
- C. Safety Awareness Policy
- D. Tolerances
- E. References.
- F. Mock-up requirements.
- G. Testing and inspection services.
- H. Manufacturers' field services.
- I. Commissioning of HVAC

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor a quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of the specified quality.
- B. Comply with the manufacturers' instructions, including each step in sequence.
- C. When the manufacturers' instructions conflict with the Contract Documents, request a clarification from the Architect before proceeding.
- D. Comply with the specified standards as a minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform the Work by persons qualified to produce the required and specified quality.
- F. Verify that field measurements are as indicated on the 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, or disfigurement.

- H. Field measurements
 - 1. Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication scheduled with construction progress to avoid construction delays.
- I. The Contractor, by approving and submitting Shop Drawings, Product Data, Samples, and similar submittals thereby represent that they have determined and verified all dimensions, quantities, field dimensions, relations to existing work, coordination with work to be installed later, coordination with information on previously accepted Shop Drawings, Product Data, Samples, or similar submittals and verification of compliance with all the requirements of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor. In reviewing Shop Drawings, Product Data, Samples, and similar submittals the Architect shall be entitled to rely upon the Contractor's representation that such information is correct and accurate.
- J. Concrete Installation Quality Control
 - 1. **NO** concrete is to be installed without prior examination by the Architect of all forms, reinforcement and vapor barriers and receipt of a written approval by the Architect.
 - 2. The Architect is to be notified a minimum of three (3) working days prior to each pour.
 - 3. All inconsistencies will be corrected, re-inspected and approved by the Architect prior to installation of the concrete.

1.03 VERIFICATION OF CREDENTIALS AND LICENSES

- A. All persons employed on the project site must have appropriate and current credentials and licenses in their possession, at the project site, for the work they are performing.
- B. Be forewarned that inspectors will be checking for verification of credentials and licenses of both union and non-union persons, in their onsite inspections.
- C. Inspectors will also be reviewing Contractor's Certified Monthly Payroll Records for conformance with RI State Prevailing Wage Rate requirements.
- D. Those persons without the appropriate credentials and licenses will be subject to dismissal from the project site.

1.04 SAFETY AWARENESS POLICY

- A. In accordance with Rhode Island General Laws, Title 28, S28-20-35 5.1 Safety awareness program required. (Effective January 1, 2002.) all contractors who bid on municipal and state construction projects with a total project cost of One Hundred Thousand Dollars(\$100,000.00) or more, shall have an OSHA "ten hour safety construction program" for their on-site employees. The training shall utilize instructors trained by the Occupational Safety Health Administration, using OSHA approved curriculum. Graduates shall receive a card from the U. S. Department of Labor Occupational Safety and Health Administration certifying the successful completion of the training course. The director of the Rhode Island Department of Labor and Training shall promulgate rules, regulations and penalties to enforce provisions of this section.

- B. The Contractor is required to conform to all applicable OSHA requirements on this project.

1.05 TOLERANCES

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

1.06 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by the date of issue current on the date of the Contract Documents, except where a specific date is established by code.
- C. Obtain copies of the standards where required by the product specification Sections.
- D. When the specified reference standards conflict with the Contract Documents, request a clarification from the Architect before proceeding.
- E. Neither the contractual relationships, duties, nor responsibilities of the parties in the Contract, nor those of the Architect, shall be altered from the Contract Documents by mention or inference otherwise in reference documents.

1.07 MOCK-UP REQUIREMENTS

- A. Tests will be performed under the provisions identified in this Section and identified in the respective product specification Sections.
- B. Assemble and erect the specified items with the specified attachment and anchorage devices, flashing, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining Work.
- D. Where the mock-up has been accepted by the Architect and is specified in the product specification Sections to be removed, remove the mock-up and clear the area when directed to do so by the Architect.

1.08 TESTING AND INSPECTION SERVICES

- A. The Contractor will engage and pay for the cost of an independent testing and inspecting firm to perform the testing and inspection services. The Contractor will submit the name of an independent firm to the Architect for approval by the Owner.
- B. The independent firm will perform the tests, inspections and other services specified in the individual specification Sections.
 - 1. Laboratory: Authorized to operate in the location in which the Project is located.
 - 2. Laboratory Staff: Maintain a full time registered Engineer on staff to review the services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either the National Bureau of Standards or to the accepted values of natural physical constants.
- C. Testing, inspections and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect.
- D. Reports will be submitted by the independent firm to the Architect, Owner and the Contractor, in duplicate, or electronically, indicating the observations and results of tests and indicating the compliance or non-compliance with Contract Documents.
- E. Cooperate with the independent firm; furnish samples of the materials, design mix, equipment, tools, storage, safe access, and the assistance by incidental labor as requested.
 - 1. Notify the Architect and the independent firm 24 hours prior to the expected time for operations requiring services.
 - 2. Arrange with the independent firm and pay for additional samples and tests required for the Contractor's use.
- F. Testing and employment of the testing firm shall not relieve the Contractor of an obligation to perform the Work in accordance with the requirements of the Contract Documents.
- G. Re-testing or re-inspection required because of a non-conformance to the specified requirements is to be performed by the same independent firm on instructions by the Architect. Payment for the re-testing or re-inspection will be the Contractor's responsibility.
- H. Testing Firm Responsibilities:
 - 1. Test samples of mixes submitted by the Contractor.
 - 2. Provide qualified personnel at the site. Cooperate with the Architect and the Contractor in performance of services.
 - 3. Perform specified sampling and testing of the products in accordance with the specified standards.
 - 4. Ascertain compliance of the materials and mixes with the requirements of the Contract Documents.
 - 5. Promptly notify the Architect and the Contractor of observed irregularities or non-conformance of the Work or products.
 - 6. Attend the preconstruction meetings and the progress meetings.

- I. Testing Firm Reports: After each test, promptly submit two copies of the report to the Architect and to the Contractor. When requested by the Architect, provide an interpretation of the test results. Include the following:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and specifications section.
 - 6. Location in the Project.
 - 7. Type of inspection or test.
 - 8. Date of test.
 - 9. Results of tests.
 - 10. Conformance with Contract Documents.
- J. Limits on Testing Firm:
 - 1. Testing Firm may not release, revoke, alter, or enlarge on the requirements of the Contract Documents.
 - 2. Testing Firm may not approve or accept any portion of the Work.
 - 3. Testing Firm may not assume any duties of the Contractor.
 - 4. Testing Firm has no authority to stop the Work.

1.09 MANUFACTURERS' FIELD SERVICES

- A. When specified in the individual specification Sections, require the material or Product suppliers, or manufacturers, to provide qualified staff personnel to observe the site conditions, the conditions of the surfaces and installation, the quality of workmanship, the start-up of equipment, or test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Submit the qualifications of the observer to the Architect thirty (30) days in advance of the required observations. The Observer is subject to approval by the Architect.
- C. Report the observations and the site decisions or instructions given to the applicators or installers that are supplemental or contrary to the manufacturers' written instructions.
- D. Refer to Section 01 33 00 - Submittal Procedures, Manufacturer's Field Reports article.

1.10 COMMISSIONING OF HVAC SYSTEM

- A. Commissioning Agency
 - 1. A Commissioning Agency (CA) will be contracted directly with the Contractor for this project. The CA has overall responsibility for planning and coordinating the commissioning process. However commissioning involves all parties to the construction process, including the Contractor.

B. Contractor Responsibility

1. **NOTE:** The Contractor will engage and pay for the cost of a Commissioning Agency to perform the commissioning. The Contractor will submit the name of an independent firm to the Architect for approval by the Owner.
2. This Section of the specifications defines the Contractor's responsibilities with respect to the commissioning process. Each Contractor and Sub-Contractor shall review this Section, and shall include in their bids for carrying out the work described, as it applies to each Division and Section of these specifications, individually and collectively.

C. Description of Work

1. The purpose of the commissioning process is to provide the owner of the facility with assurance that the mechanical system has been installed according to the contract documents, and operates within the performance guidelines set out in the design intent documents and these specifications. The CA will provide the owner with an unbiased, objective view of the system's installation, operation, and performance. The commissioning process does not take away or reduce the responsibility of the installing contractors to provide a finished product, installed and fully functional in accordance with the contract documents.
2. Commissioning is intended to enhance the quality of system start-up and aid in the orderly completion and transfer of systems for beneficial use by the owner. The CA will be the leader of the commissioning team, planning and coordinating all commissioning activities in conjunction with the design professionals, contractor, subcontractors, manufacturers and equipment suppliers.
3. The General Contractor, Mechanical Contractor and all Division 23 sub-contractors shall be responsible for cooperating, and coordinating their work, with the CA. They shall also be responsible for carrying out all the physical activities required for installation of components and systems, and operating them during the commissioning process as required.

D. Related Documents

1. Drawings and general provisions of the contract, including general and supplementary conditions, general mechanical provisions and the applicable Division 23 specification section, apply to work of this section.
2. The following section pertains directly with the commissioning requirements:
Section 01 91 00 - General Commissioning Requirements

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary lighting for construction purposes.
 - 3. Temporary heating.
 - 4. Temporary ventilation.
 - 5. Temporary water service.
 - 6. Temporary sanitary facilities.
- B. Construction Facilities:
 - 1. Storage sheds and trailers.
 - 2. Field office
 - 3. Temporary scaffolding
 - 4. Hoisting
 - 5. Vehicular access.
 - 6. Parking.
 - 7. Progress cleaning and waste removal.
- C. Temporary Controls:
 - 1. Barriers
 - 2. Protection of Property
 - 3. Enclosures
 - 4. Dust control.
 - 5. Noise control.
 - 6. Pollution control.
 - 7. Fire Detection
 - 8. Pest control.
 - 9. Rodent control.

1.02 TEMPORARY ELECTRICITY

- A. The Owner will pay the cost of energy used. Exercise measures to conserve energy. Utilize the Owner's existing power service.
- B. Permanent convenience receptacles may be utilized during construction.

1.03 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting for construction operations to achieve a minimum lighting level of 2 watt/sq ft.
- B. Permanent building lighting may be utilized during construction.

1.04 TEMPORARY HEATING

- A. Existing heating equipment may be used.
- B. The Owner will pay the cost of heat. Exercise measures to conserve energy. Utilize the Owner's existing heat plant, extend and supplement with temporary heat devices as needed to maintain the specified conditions for construction operations.
- C. Maintain a minimum ambient temperature of 50 degrees F in the areas where construction is in progress, unless indicated otherwise in the product Sections.

1.05 TEMPORARY VENTILATION

- A. Ventilate the enclosed area to achieve a curing of materials, to dissipate humidity, and to prevent the accumulation of dust, fumes, vapors, or gases.
- B. Utilize the existing ventilation equipment. Extend and supplement the equipment with temporary fan units as required to maintain clean air for construction operations.

1.06 TEMPORARY WATER SERVICE

- A. The Owner will pay the cost of temporary water. Exercise measures to conserve energy. Utilize the Owner's existing water system, extend and supplement with temporary devices as needed to maintain the specified conditions for construction operations.

1.07 TEMPORARY SANITARY FACILITIES

- A. An existing designated sanitary facility may be used during construction operations. Maintain daily in a clean and sanitary condition. The sanitary facility marked as 'Family' will not be available. Coordinate with Owner.
- B. At the end of construction, return the facilities to the same or better condition as the original condition.

1.08 STORAGE SHEDS AND TRAILERS

- A. Storage Areas, Sheds and Trailers: Size to the storage requirements for the products of the individual Sections, allowing for access and orderly provision for the maintenance and for the inspection of Products to the requirements of Section 01 60 00.
- B. Maintenance and Cleaning
 - 1. Maintain the approach walks free of mud, water, and snow.
- C. Removal: At the completion of the Work remove the trailers, temporary buildings, utility services, and debris. Restore the areas to original condition.

1.09 FIELD OFFICE

- A. The existing building may not be used for an office during construction. It is the Contractor's option to provide a trailer and place it in a location approved by the Architect and Owner.

1.10 TELEPHONE SERVICE

- A. The Contractor is required to insure the on-site Project Supervisor maintains a cell phone in their possession for the duration of the Contract.

1.11 TEMPORARY SCAFFOLDING

- A. Contractor is to provide temporary scaffolding as necessary for construction purposes.
- B. The scaffolding is to be braced properly, assembled and installed as required to meet all OSHA requirements.
- C. Remove from the site all scaffolding, associated bracing and supports upon completion of construction. Repair all surfaces and site to original condition.

1.12 HOISTING

- A. Contractor is responsible for all hoisting required to facilitate, serve, stock, clean, and complete the Work. Include all costs for operating engines, fuel, delivery and removal, mobilization, staging, protection of grades and surfaces, and equipment. All surfaces damaged by hoisting equipment or crane are to be cleaned and repaired to match original condition. All damaged grass is to receive loam and seed to match existing.
The Contractor is responsible to adhere to all OSHA requirements.

1.13 VEHICULAR ACCESS

- A. Provide unimpeded access for emergency vehicles. Maintain 20 foot width driveways with turning space between and around combustible materials.
- B. Provide and maintain access to fire hydrants and control valves free of obstructions.
- C. Use designated existing on-site roads for construction traffic.

1.14 PARKING

- A. Arrange for temporary surface parking areas to accommodate the construction personnel.
- B. Location must be approved by the Owner.
- C. Use of existing parking facilities by construction personnel is permitted.
- D. When site space is not adequate, arrange through the Owner for additional off-site parking.

- E. Use of designated existing on-site streets and driveways for construction traffic is permitted. Tracked vehicles are not allowed on paved areas.
- F. Do not allow heavy vehicles or construction equipment in parking areas.

1.15 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain the site in a clean and orderly condition.
- B. Collect and remove waste materials, debris, and rubbish from the site periodically, weekly, or daily, as necessary to prevent an on-site accumulation of waste material, debris, and rubbish, and dispose off-site.
- C. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.16 BARRIERS

- A. Provide barriers to prevent unauthorized entry to the construction areas and to protect existing facilities from damage from the construction operations, or demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way, or for public access to and egress from the existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.17 PROTECTION OF PROPERTY

- A. **NOTE:** The Contractor is required to follow all protocols stipulated in NFPA 909 (2017) – Code for Protection of Cultural Resource Properties.
This code describes principles and practices of protection for cultural resource properties (museums, libraries, and places of worship) and their contents and collections from conditions or physical situations with the potential to cause damage or loss. The Code outlines a comprehensive protection program addressing all areas including fire prevention; fire protection management; security; emergency preparedness; and inspection, testing, and maintenance of protection systems.

1.18 ENCLOSURES

- A. Provide temporary fire resistant polyethylene dust drapes as required to separate the work areas from the Owner occupied areas, to prevent penetration of dust and moisture into the Owner occupied areas, and to prevent damage to the existing materials and equipment. Seal perimeter as required.

1.19 DUST CONTROL

- A. Execute the Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into the atmosphere.

1.20 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by the construction operations.
- B. Restrictions on Noise:
 - 1. Use equipment with well-maintained mufflers.
 - 2. Use the least noisy techniques practical.
 - 3. Schedule noisy activities when ambient background noise level is highest.
 - 4. Turn off all unneeded and idling equipment and engines.
 - 5. Locate noise sources as far as practical from noise sensitive locations.
 - 6. Orient noise sources away from noise sensitive locations

1.21 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent the contamination of soil, water, and the atmosphere from discharge of noxious, toxic substances, and pollutants produced by the construction operations.

1.22 FIRE DETECTION

- A. Before beginning any construction that can potentially trigger the existing fire detection system, notify the Owner and request to temporarily disconnect the system in the specific areas of construction, for as long as may be necessary.

1.23 PEST CONTROL

- A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work, or entering the facility.

1.24 RODENT CONTROL

- A. Provide methods, means, and facilities to prevent rodents from accessing or invading the premises.

PART-2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

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SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Product substitution procedures.

1.02 PRODUCTS

- A. Products: Means new material, machinery, components, fixtures, or systems forming the Work; but does not include the machinery or equipment used for the preparation, fabrication, conveying, or erection of the Work. Products may include the existing materials or components required or specified for reuse.
- B. Furnish products of qualified manufacturers suitable for the intended use. Furnish products of each type by a single manufacturer unless specified otherwise.
- C. Do not use materials and equipment removed from the existing premises, except as specifically permitted by the Contract Documents.
- D. Furnish interchangeable components of the same manufacturer for the components being replaced.

1.03 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with the manufacturer's instructions.
- B. Promptly inspect shipments to ensure that the products comply with the requirements, the quantities are correct, and the products are undamaged.
- C. Provide equipment and personnel to handle the products by methods to prevent soiling, disfigurement, or damage.

1.04 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect the products in accordance with the manufacturers' instructions.
- B. Store with seals and labels intact and legible.

- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to the product.
- D. For exterior storage of fabricated products, place on sloped supports above the ground.
- E. Provide bonded off-site storage and protection when the site does not permit on-site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent the condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store the products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of the products to permit access for inspection. Periodically inspect to verify that the products are undamaged and are maintained in acceptable condition.

1.05 PRODUCT OPTIONS

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

1.06 PRODUCT SUBSTITUTION PROCEDURES

- A. Throughout these Specifications, types of materials may be specified by manufacturer's name, and product information in order to establish standards of quality and performance and not for the purpose of limiting competition.
- B. Inclusion of additional names of manufacturers, other than the Basis of Design manufacturer, does not imply acceptability of standard products from those manufacturers listed. All manufacturers listed shall conform, with modification as necessary, to criteria established by the specification for performance, efficiency, materials, finishes and special accessories along with, at a minimum, matching the Basis of Design product.
- C. No substitutions will be considered prior to receipt of Bids unless written request for approval (by hard copy or email) has been received by the Architect at least 10 calendar days prior to the Bid due date. If the product substitution is approved prior to receipt of the Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals announced in any other manner.

It will be the Architect's and Owner's option to consider a formal request, review and acceptance of a product substitution following award of the contract. For all requests made after award of the contract, the Architect will review the requests with reasonable promptness and notify the Contractor in writing of the decision to accept or reject the substitution.

- D. A request for substitution of any manufacturer or product not named in a specification section is to be submitted in accordance with the following.
1. Document each request with complete data substantiating the compliance of a proposed Substitution with the Contract Documents.
 2. A request constitutes a representation that the Contractor:
 - a. Has investigated the proposed product and determined that it is equal to or superior in all respects to the specified product.
 - b. Will provide the same warranty for the substitution as for the specified product.
 - c. Will coordinate the installation and make changes to other Work that may be required for the Work to be complete with no additional cost to the Owner.
 - d. Waives claims for additional costs or time extension that may subsequently become apparent.
 - e. Will coordinate installation with all affected trade Contractors, specialty Contractors and the like and will be responsible for any and all costs which may arise as a result of this substitution.
 - f. Will reimburse the Owner and the Architect for review or redesign services associated with re-approval by the authorities having jurisdiction.
- E. Substitutions will not be reviewed when a substitution is implied on the Shop Drawing or Product Data submittals without a separate written request or when acceptance will require revision to the Contract Documents.
- F. If the Contractor proposes to use a material which, while suitable for the intended use, deviates in any way from the detailed requirements of the Contract Documents, the Contractor shall inform the Architect in writing of the nature of such deviations at the time the material is submitted for review.
- G. Substitution Submittal Procedure:
1. Submit the Request for Substitution letter, Shop Drawings, Product Data, direct comparison table and the certified test results attesting to the proposed product equivalence by E-mail via an electronic format (PDF) copy to the Architect. Assemble package into a single indexed file incorporating all the required information.
 2. The Contractor shall submit a separate request for each product substitution.
 3. Provide direct comparison between the specified product and the proposed substitution. The burden of proof is on the proposer.
Supporting data to be submitted to permit a fair evaluation of the proposed substitution must address:
 - a. Performance;
 - b. Capacity;
 - c. Efficiency;
 - d. Safety;
 - e. Function;
 - f. Appearance;
 - g. Quality and durability;

- h. Finish;
 - i. Warranty terms and conditions;
 - j. Directly compare, side-by side, in table format, all listed testing agency performance requirements;
 - k. Delivery times and effect on schedules, if any;
 - l. Changes in space requirements or affect on other elements of work, if any;
 - m. Availability of maintenance service and source of replacement materials, if applicable.
- H. The Contract Documents are intended to produce a building of consistent character and quality of design. All components of the building including visible items of mechanical and electrical equipment have been selected to have a coordinated design in relation to the overall appearance of the building. The Architect shall judge the design and appearance of proposed substitutes on the basis of their suitability in relation to the overall design of the Project, as well as for their intrinsic merits. The Architect will not approve as equal to materials specified proposed substitutes which, in the Architect's opinion, would be out of character, obtrusive, or otherwise inconsistent with the character or quality of design of the Project. In order to permit coordinated design of color and finishes the Contractor shall, if required by the Architect, furnish the substituted material in any color, finish, texture, or pattern which would have been available from the manufacturer originally specified, at no additional cost to the Owner.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 70 00

EXECUTION REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Examination.
- B. Preparation.
- C. Protection of adjacent construction.
- D. Cutting and patching.
- E. Special procedures.
- F. Progress cleaning and waste removal.
- G. Final cleaning.
- H. Starting and adjusting of systems.
- I. Demonstration and Instructions.
- J. Testing and adjusting.
- K. Protecting Installed Construction.

1.02 EXAMINATION

- A. Acceptance of Conditions:
 - 1. Verify that the existing applicable site conditions, substrates, or substrate surfaces are acceptable or meet the specific requirements of the individual specifications Sections, for subsequent Work to proceed.
 - 2. Verify that the existing substrate is capable of structural support or attachment of new Work being applied or attached.
 - 3. Examine and verify specific conditions described in the individual specifications Sections.
 - 4. Verify that utility services are available, of the correct characteristics, and in the correct locations.
 - 5. Beginning of new Work, that relies upon the quality and proper execution of the Work of a preceding trade, means acceptance of that preceding Work as appropriate for the proper execution of subsequent Work.
 - 6. Acceptance of preceding Work that can be shown later to have adversely affected proper performance of new Work may result in removal and repeat performance of all Work involved at no cost to the Owner.

1.03 PREPARATION

- A. Clean substrate surfaces prior to applying the next material or substance.
- B. Seal cracks or openings of the substrate prior to applying the next material or substance.
- C. Apply a manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.
- D. Prior to the application, installation, or erection of any products and product components, perform any other preparatory operations, or surface or substrate modifications, as may be specified or directed by the product manufacturers.

1.04 PROTECTION OF ADJACENT CONSTRUCTION

- A. Protect the existing adjacent properties and provide special protection where specified in the individual Specification Sections.
- B. Provide protective coverings at wall, projections, jambs, sills, and soffits of the existing openings.
- C. Protect the existing finished floors, stairs, and other existing surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- D. Repair adjacent properties damaged by the construction operations to the original condition to the satisfaction of the Owner.
- E. Prohibit unnecessary traffic from the existing landscaped areas.
- F. Restore the grassed landscaped areas damaged by the construction operations to a full healthy growth by installing loam and sod.

1.05 CUTTING AND PATCHING

- A. Employ the original, or skilled and experienced installer to perform cutting and patching.
- B. Submit a written request in advance of the cutting or altering elements which affect:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of the element.
 - 4. Visual qualities of sight-exposed elements.
 - 5. Existing construction, or the Work of separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete the Work, and to:
 - 1. Fit the several parts together, to integrate with the other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in the elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods that will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.

- E. Cut masonry, concrete, and other rigid materials using a masonry saw or core drill.
- F. Restore the Work with new Products in accordance with the requirements of Contract Documents.
- G. Fit Work tight to the pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- H. Maintain the integrity of the wall, ceiling, or floor construction; completely seal voids.
- I. At the penetration of fire rated partition, ceiling, or floor construction completely seal the voids with a fire rated or fire resistant material to the full thickness of the penetrated element as required to equal the rating of the surrounding construction.
- J. Refinish surfaces to match the adjacent finishes. For continuous surfaces refinish to nearest intersection; for an assembly refinish the entire unit.
- K. Identify any hazardous substance or conditions exposed during the Work to the Architect for a decision or remedy.

1.06 SPECIAL PROCEDURES

- A. Materials: As specified in the product Sections; match the existing with new products, or salvaged products as appropriate, for patching and extending work.
- B. Employ a skilled and experienced installer to perform alteration work.
- C. Cut, move, or remove items as necessary for access to the alterations and renovation Work. Replace and restore at completion.
- D. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace the materials as specified for finished Work.
- E. Remove the debris and abandoned items from the area and from concealed spaces.
- F. Prepare the surface and remove surface finishes to provide the installation of new Work and finishes,
- G. Close the openings in exterior surfaces to protect the existing Work from the weather and extremes of temperature and humidity.
- H. Remove, cut, and patch the Work in a manner to minimize damage and to provide a means of restoring products and finishes to the original or specified condition.
- I. Refinish the existing visible surfaces to remain in renovated rooms and spaces to the specified condition for each material, with a neat transition to the adjacent finishes.
- J. Where new Work abuts or aligns with the existing, provide a smooth and even transition. Patch the Work to match the existing adjacent Work in texture and appearance.

- K. When finished surfaces are cut so that a smooth transition with the new Work is not possible, terminate the existing surface along a straight line at a natural line of division and submit a recommendation to the Architect for review.
- L. Where a change of plane of 1/4 inch or more occurs, submit a recommendation for providing a smooth transition to the Architect for review.
- M. Patch or replace the portions of existing surfaces which are damaged, or showing other imperfections.
- N. Finish surfaces as specified in the individual product Sections or as indicated on the Drawings.

1.07 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain the site in a clean and orderly condition.
- B. Remove the debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Sweep and vacuum clean the interior areas prior to the start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove the waste materials, debris, and rubbish from the site periodically or weekly and dispose of off-site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.08 FINAL CLEANING

- A. Execute final cleaning of areas affected by the Work prior to the final project assessment.
- B. Clean the 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.
- C. Clean the equipment and fixtures to a sanitary condition using cleaning materials appropriate to the surface and material being cleaned.
- D. Clean or replace filters of operating equipment as directed by the Architect.
- E. Clean the debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean the site; sweep the paved areas, rake clean the landscaped surfaces.
- G. Remove the waste and surplus materials, rubbish, and the construction facilities from the site.

1.09 STARTING AND ADJUSTING OF SYSTEMS

- A. Coordinate the schedule for the starting and adjusting of various equipment and systems.

- B. Notify the Architect and the Owner seven days prior to the starting and adjusting of each item.
- C. Verify that each piece of equipment or system has been checked for the proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
- D. Verify that the tests, meter readings and the specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute the starting and adjusting under the supervision of the responsible Contractor's personnel or manufacturer's representative, in accordance with the manufacturer's instructions.
- G. Adjust the operating Products and equipment to ensure smooth and unhindered operation.
- H. When specified in the individual specifications Section, require the manufacturer to provide the authorized representative to be present at the site to inspect, check, and approve the equipment or system installation prior to starting, and to supervise the placing of equipment or system in operation.
- I. Submit a written report in accordance with Section 01 43 00 that the equipment or system has been properly installed and is functioning correctly.

1.10 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate the operation and maintenance of Products to the Owner's personnel two weeks prior to the date of Substantial Completion.
- B. For equipment or systems requiring seasonal operation, perform a demonstration for the other season within six months.
- C. Utilize the operation and maintenance manuals as the basis for instruction. Review the manuals with the Owner's personnel in detail to explain all aspects of the operation and maintenance.
- D. Demonstrate the start-up, operation, control, adjustment, trouble shooting, servicing, maintenance, and shutdown of each item of equipment at a scheduled or agreed upon time, at the equipment or system location.
- E. Prepare and insert additional data in the operations and maintenance manuals when the need for additional data becomes apparent during the instruction.

1.11 TESTING, ADJUSTING, AND BALANCING

- A. The Contractor-hired independent testing firm will submit reports to the Architect, Owner and Contractor indicating the observations and test results along with indicating the compliance or non-compliance with the specified Contract Document requirements.
The independent firm will perform the services specified in the individual specifications Sections.

1.12 PROTECTING INSTALLED CONSTRUCTION

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

PART 2 - PRODUCTS
Not Used.

PART 3 - EXECUTION
Not Used.

END OF SECTION

SECTION 01 74 19

WASTE MATERIALS MANAGEMENT AND RECYCLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 WASTE MANAGEMENT GOALS FOR THE PROJECT

- A. The Owner has established that this Project shall generate the least amount of waste possible and that processes shall be employed that ensure the generation of as little waste as feasible including prevention of damage due to mishandling, improper storage, contamination, inadequate protection or other factors as well as minimizing overall packaging and poor quantity estimating.
- B. Of the inevitable waste that is generated, the waste materials designated in this specification shall be salvaged for reuse or recycling. Waste disposal in landfills or incinerators shall be minimized. On new construction projects this means careful recycling of job site waste, on demolition projects this also means careful removal for salvage.

1.03 SUMMARY:

- A. This Section includes required salvage and recycling of the following waste materials and applies to all such listed waste materials produced during the course of this Contract:
 - 1. Concrete, Masonry, and Other Inert Fill Material: Concrete, brick, rock, clean soil not intended for other on-site use, broken up asphalt pavement containing no ABC stone, clay, concrete, or other contaminants, and other inert material.
 - 2. Metals: Metal scrap including iron, steel, copper, brass, and aluminum.
 - 3. Untreated Wood: Unpainted, untreated dimensional lumber, plywood, oriented strand board, masonite, particleboard, and wood shipping pallets.
 - 4. Gypsum Wallboard Scrap: Excess drywall construction materials including cuttings, other scrap, and excess materials.
 - 5. Cardboard: Clean, corrugated cardboard such as used for packaging, etc.
 - 6. Paper: Discarded office refuse such as unwanted files, correspondence, etc.
 - 7. Plastic Buckets: Containers for various liquid and semi-solid or viscous construction materials and compounds.
 - 8. Beverage Containers: Aluminum, glass, and plastic containers.
 - 9. Other Mixed Construction and Demolition Waste: Solid waste resulting solely from construction, remodeling, repair, or demolition operations on pavement, buildings, or other structures exclusive of waste materials listed herewith.
 - 10. Materials to be salvaged if possible:
 - a. Dimensioned Lumber and Heavy Timbers.
 - b. Structural Steel.
 - c. Insulation.
 - d. Brick and block.
 - e. Electric Equipment and Light Fixtures.
 - f. Plumbing fixtures and brass.

- B. Non-Recyclable Waste: Collect and segregate non-recyclable waste for delivery to a permitted landfill site.
 - 1. Mixed Solid Waste: Solid waste usually collected as a municipal service, exclusive of waste materials listed above.

1.04 HAZARDOUS MATERIAL SUSPICION

- A. If, during the course of construction, the Contractor suspects a material to contain asbestos, all work involving the material is to be stopped and the Architect notified immediately of the suspicion. Until the material is confirmed to be safe or tested and determined to be an asbestos containing material, the Contractor is to assume it contains asbestos and is to avoid contact. Upon notification of its composition the Architect will determine the course of action and inform the Contractor accordingly.

1.05 DEFINITIONS:

- A. Waste Materials are defined as large and small pieces of the materials indicated which are excess to the contract requirements and generally include materials which are to be salvaged from existing construction and items of trimmings, cuttings and damaged goods resulting from new installations, which can not be effectively used in the Work.

1.06 SUBMITTALS:

- A. Show compliance with regulations specified under "Quality Assurance" article below. Include a list of recycling facilities to which indicated recyclable materials will be distributed for disposal. Identify materials that are not recyclable or otherwise conservable that must be disposed of in a landfill or other means acceptable under governing State and local regulations. List permitted landfills and/or other disposal means to be employed. Indicate any instances where compliance with requirements of this specification does not appear to be possible and request resolution from the Architect.
- B. Delivery Receipts: Provide delivery receipts for waste materials salvaged and sent to permitted waste materials processors or recyclers within 48 hours of delivery that indicate the location and name of firm accepting recyclable waste materials, types of materials, net weights of each type, date of delivery and value of materials. Hazardous weights are not to be included.
- C. Application for Payments: The Contractor shall submit with each Application for Payment a summary of waste materials, recycled, salvaged and disposed of using a form generated by the Contractor and approved by the Architect. Failure to submit this information shall render the Application for Payment incomplete and shall delay Payment. The Summary shall contain the following information: For each material salvaged and recycled from the Project, include the amount (in cubic yards or tons or in the case of salvaged items state quantities by number, type and size of items) and the destination (i.e. recycling facility, used building materials yard). For each material land filled or incinerated from the Project, include the amount (in cubic yards or tons) of material and the identity of the landfill, incinerator or transfer station.

1.07 QUALITY ASSURANCE:

- A. Regulatory Requirements: Comply with all applicable requirements of the federal, state or local authorities concerning Management of Construction, Demolition, Land Clearing, Inert, and Yard Trash Debris
- B. Disposal Sites, Recyclers, and Waste Materials Processors: Use only facilities properly permitted by the State and by local authorities where applicable.
- C. Implementation: Include a discussion of waste management and recycling in worker orientation. Provide on-site instruction on appropriate separation, handling, recycling, and salvaging methods to be used by all parties at the appropriate stages of the work at the site. Include waste management and recycling discussion in pre-fabrication meetings with subcontractors and fabricators. Also include discussion of waste management and recycling in regular job meetings and job safety meetings conducted during the course of work at the site.

1.08 STORAGE AND HANDLING:

- A. Site Storage: Remove all indicated recyclable materials from the work location to approved containers daily. Failure to remove waste materials will be considered cause for withholding payment and termination of Contract.
- B. Position covered containers for recyclable waste materials at a designated location on the Project Site. Select a location for the recyclable materials containers separated from that of general waste and rubbish containers. Provide separate collection containers for a minimum of the following materials:
 - 1. Untreated lumber.
 - 2. Gypsum wallboard.
 - 3. Paper, paper products, and cardboard.
 - 4. Plastics.
 - 5. Metals.
 - 6. Glass.
 - 7. Other salvageable materials.
- C. Change out loaded containers for empty ones as demand requires, but not less than weekly.
- D. Handling: Deposit all indicated recyclable materials in the containers in a clean (no mud, adhesives, solvents, petroleum contamination), debris-free condition. Do not deposit contaminated materials into the containers until such time as such materials have been cleaned.
- E. If the contamination chemically combines with the material so that it can not be cleaned, do not deposit into the recycle containers. Comply disposal with all legal and regulatory requirements.

1.09 PROJECT/SITE CONDITIONS:

- A. Environmental Requirements: Transport recyclable waste materials from the Work Area to the recycle containers and carefully deposit in the containers without excess noise and interference with other activities, in a manner to minimize noise and dust. Reclose container covers immediately after materials are deposited.

1. Do not place recyclable waste materials on the ground adjacent to a container.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 WASTE MANAGEMENT:

- A. General: Implement waste management procedures throughout the life of this Contract.
- B. Source Separation: Separate, store, protect, and handle at the project site all identified recyclable and salvageable waste products to prevent contamination of materials and maximize recyclability and salvageability of materials.
- C. Arrange for the regular collection, transport from the site, and delivery to respective approved recycling centers of indicated recyclable waste materials. Maintain records accessible to the Architect for verification of construction waste materials recycling.
- D. Delivery Receipts: Arrange for timely pickups from the site or deliveries to approved recycling facilities of designated waste materials to keep construction site clear and prevent contamination of recyclable materials. Keep and maintain records of all deliveries to recycling facilities and all pickups of waste materials at the site by others as specified above.

3.02 RECYCLABLE WASTE MATERIALS HANDLING:

- A. General: The following paragraphs supplement handling requirements for various materials identified for classification and recycling listed in Part 1 "Summary" article above.
- B. Paper: Classify and handle waste paper goods as follows:
 1. Bond Paper: As generally found in the construction offices and used for specifications, correspondence, copiers, printers and FAX machines. Collect in a separate container at each workstation and deposit loose in the appropriate recycle container daily.
 2. Newsprint: Newspapers and tabloid style advertising. Collect in a single location and deposit daily in the appropriate recycle container.
 3. Prints (drawings): Set up a single location for collection. Roll together to minimize space. Deposit daily in the appropriate recycle container.
- C. Packaging materials:
 1. Cardboard and paperboard cartons and boxes: Knock-down, fold flat and deposit in the appropriate recycle container.
 2. Paper packing materials (separators, stiffeners, etc.) shall be placed in the same container.
 3. Newsprint, used as packing (shredded or whole), shall be deposited in the recyclable container for newsprint.
 4. Plastic (polystyrene peanuts and other shapes) shall be deposited in the recyclable container for plastics.
 5. Metal and plastic banding materials shall be deposited in the appropriate container.
- D. Metals: Cut all items to lengths and sizes to fit within the container provided, when necessary. Where there is sufficient quantity of a specific recyclable waste item (for example; salvaged metal roofing or duct work), make special arrangements for items to be bundled, banded or tied, and

stack in a designated location for a special pick-up. Coordinate all special arrangements with the Architect.

- E. Plastics: Collect recyclable plastics (polystyrene and others specifically marked for recycling) daily from work areas and deposit in designated containers.
- F. Glass: Remove waste glass products (sheet, bottles, etc.) daily from the work area and deposit in designated containers. Glass containing imbedded wire (typical in some fire rated doors having glazed lights) is not recyclable.
- G. Gypsum Wallboard: Separate gypsum wallboard from other wastes. Dispose of waste gypsum wallboard off-site at a gypsum reclamation or recycling facility.
- H. Other Items: Where recyclability classification of any given waste material is unclear, verify with the Architect.

END OF SECTION

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SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Closeout procedures.
- B. Quality assurance.
- C. Maintenance service.
- D. Owner's Manuals
- E. Operations and maintenance manuals.
- F. Materials and finishes manuals.
- G. Equipment and systems manuals
- H. Spare parts and maintenance materials.
- I. Product warranties and product bonds.
- J. Project Record documents.
- K. Project close out inspections – Punch List

1.02 CLOSEOUT PROCEDURES

- A. Submit a written certification that the Contract Documents have been reviewed, the Work has been inspected, and that the Work is complete in accordance with the Contract Documents and is ready for the Architect's review.
- B. Provide submittals to Architect that are required by the governing or other authorities, including the following closeout documents:
 - 1. AIA Document G706 - Contractor's Affidavit of Payment of Debts and Claims, 1994 Edition.
 - 2. AIA Document G706A - Contractor's Affidavit of Release of Liens, 1994 Edition.
 - 3. AIA Document G707 - Consent of Surety to Final payment, 1994 Edition.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. The Owner will occupy all portions of the building as specified in Section 01 10 00.

- E. Provide submittals to Architect that are required by governing or other authorities, including abatement invoices correctly prepared as prescribed in Section 02 81 13. Failure to include correctly prepared abatement invoices will delay issuing of final payment.

1.03 QUALITY ASSURANCE

- A. Employ personnel assembling submittals experienced in the maintenance and the operation of the described products and systems.

1.04 MAINTENANCE SERVICE

- A. Submit a contract for furnishing service and maintenance of the components indicated in the specification Sections for one year from date of Substantial Completion, or during the warranty period, whichever period of time is the longest.
- B. Provide for an examination of the system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include a systematic cleaning, examination, adjustment, and lubrication of the components. Repair or replace the parts whenever required. Use the parts produced by the manufacturer of the original component.
- D. Do not assign or transfer the maintenance service to an agent or Subcontractor without the prior written consent of the Owner.

1.05 OWNER'S MANUALS

- A. Submit the data for Operations and Maintenance, Materials and Finishes, and Equipment and Systems Manuals bound in 8-1/2 x 11 inch text pages, in maximum 2 inch size, D side three - ring commercial quality binders with durable cleanable plastic covers.
- B. Prepare binder covers with the printed title of the manual, title of the project, and the subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Drawings: Provide with reinforced punched binder tab. Bind in with the text; fold the larger drawings to the size of the text pages.
- E. Submit one copy of the completed volumes for review. They will be reviewed and returned with the Architect's comments. Revise the content of the manuals as required prior to final submission.
- F. Submit one set of revised final volumes in final form.
- G. Submit one copy of all the manuals for Operations and Maintenance, Materials and Finishes, and Equipment and Systems in PDF electronic format on a Compact Disc or DVD.

1.06 OPERATIONS AND MAINTENANCE MANUALS

- A. Contents: Prepare the Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing the names, addresses, and telephone numbers of the Architect, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by the specification Section. For each category, identify the names, addresses, and telephone numbers of the Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds.
 - e. MSDS for applicable products.

1.07 MATERIALS AND FINISHES MANUALS

- A. Instruction for Care and Maintenance: include manufacturer's instructions for cleaning agents and methods, precautions against detrimental agents and methods, and a recommended schedule for cleaning and maintenance.
- B. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- C. Include Material Safety Data Sheets (MSDS) for all applicable products. These are required to provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. MSDS's include information such as physical data (melting point, boiling point, flash point etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill/leak procedures.
- D. Additional Requirements: As specified in the individual product specification Sections.
- E. Include a listing in the Table of Contents for design data, with a tabbed flysheet and a space for the insertion of data.

1.08 EQUIPMENT AND SYSTEMS MANUALS

- A. For equipment, or component parts of equipment put into service during construction and operated by the Owner, submit documents within 10 days after acceptance.
- B. Each Item of Equipment and Each System: Include a description of the unit or system, and the component parts. Identify the function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; by label machine.
- D. Include color-coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- G. Include a servicing and lubricating schedule, and a list of lubricants required.
- H. Include the manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by the controls manufacturer.
- J. Include the original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Include control diagrams by the controls manufacturer as installed.
- L. Include the Contractor's coordination drawings, with color-coded piping diagrams as installed.
- M. Include charts of valve tag numbers, with the location and function of each valve, keyed to the flow and control diagrams.
- N. Include a list of the original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- O. Include test and balancing reports.
- P. Additional Requirements: As specified in the individual product specification Sections.
- Q. Include a listing in the Table of Contents.

1.09 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in the quantities specified in the individual specification Sections.
- B. Deliver to the Project site and place in a location as directed by the Owner; obtain a receipt prior to final payment.

1.10 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by the responsible subcontractors, suppliers, and manufacturers, within 10 days after the completion of the applicable item of work.
- B. Execute and assemble the transferable warranty documents and bonds from the subcontractors, suppliers, and manufacturers.
- C. Verify that the documents are in the proper form, contain full information, and are notarized.
- D. Co-execute the submittals when required.
- E. Submit two copies in D side three ring binders with a durable plastic cover.
- F. Submit prior to the final Application for Payment.
- G. Time of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with the Owner's permission, submit the documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after the Date of Substantial Completion, prior to the final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond the Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty or bond period.

1.11 PROJECT RECORD DOCUMENTS

- A. Maintain on the site one set of the following record documents; record actual revisions of the Work for all trades:
 - 1. Construction drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instructions for assembly, installation, and adjusting.
- B. Ensure the entries are complete and accurate, enabling future reference by the Owner.
- C. Store the record documents separate from the documents used for construction.
- D. Record information concurrent with the construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product Section description of the 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. Construction Record Drawings and Shop Drawings: Legibly mark each item to record the actual construction including:
1. Measured locations of internal utilities and appurtenances concealed in the construction.
 2. Field changes of dimension and detail.
 3. Details not on the original contract construction drawings.
- G. Legibly marked Specifications, and legibly marked Record Construction Drawings and Shop Drawings shall constitute the Project Record Documents.
- H. Update the on-site Project Record Documents on a regular basis. Monthly payments will not be processed if Project Record Documents are not maintained up to date.
- I. At completion of the Work of the Contract, the Architect will furnish the Contractor with an electronic copy of the construction drawings in AutoCad or Autodesk Revit format, and the Project Manual content in Adobe Acrobat PDF format.
- J. Transfer the information from the Project Record Documents onto the electronic documents (Drawings in AutoCad or Autodesk Revit format and the Project Manual in Adobe Acrobat PDF format copied onto a USB flash drive. These documents will constitute the As-Built Documents. Deliver the As-Built Documents to the Architect as two copies on paper and two USB Flash drives. The two paper copies are to be bound and printed full size. Also deliver the paper Project Record Documents to the Architect.
- K. The Architect will review the As-Built Documents and compare them with the Project Record Documents for accuracy, and if necessary return them to the Contractor for final correction. At the time of final submission of the As-Built documents, submit the final Application for Payment.
- L. No review or receipt of record of As-Built Documents by the Architect or the Owner shall be interpreted as a waiver of any deviation from the Contract Documents or Shop Drawings , or in any way relieve the Contractor from responsibility to perform the Work in accordance with the Contract Documents and the Shop Drawings to the extent they are in accordance with the Contract Documents
- M. Abatement Invoices: Application for Final Payment must be accompanied with shipping documents for disposal of the abated material as specified in Section 02 81 13.
- N. At completion of the Work of the Contract submit to the Architect a summary of waste materials, recycled, salvaged and disposed of as outlined in Section 01 74 19.
The Summary shall contain the following information:
For each material salvaged and recycled from the Project, include the amount (in cubic yards or tons or in the case of salvaged items state quantities by number, type and size of items) and the destination (i.e. recycling facility, used building materials yard). For each material land filled or incinerated from the Project, include the amount (in cubic yards or tons) of material and the identity of the landfill, incinerator or transfer station.

- O. At completion of the Work of the Contract submit to the Architect (as outlined in Section 01 74 19) delivery receipts for waste materials salvaged and sent to permitted waste materials processors or recyclers that indicate the location and name of firm accepting recyclable waste materials, types of materials, net weights of each type, date of delivery and value of materials.
- P. At completion of the Work of the Contract submit to the Architect a table indicating information pertaining to construction materials used on the project that includes the following:
 - Name of the material
 - Amount of low emissive VOC
 - Percentage of pre-consumer recycled content
 - Percentage of post consumer recycled content
 - Distance product was manufactured from construction site (Greater or less than 500 miles)

Also submit written documentation substantiating the information in the form of a manufacturer's cut sheet, material safety data sheet or letter from the manufacturer.

1.12 PROJECT CLOSE OUT INSPECTIONS - PUNCH LIST

- A. When the work has reached such a point of completion that the building or buildings, equipment, apparatus or phase of construction or any part thereof required by the Owner for occupancy or use can be so occupied and used for the purpose intended, the Contractor, prior to notification to the Architect, shall make a preliminary inspection of the Work to insure that all requirements of the Contract have been met and the Work is substantially complete and is acceptable. Upon such notification, the Owner or the Architect and the consulting Engineers shall make detailed inspection of the Work to insure that all requirements of the Contract have been met and the Work is complete and is acceptable.
- B. Within ten (10) calendar days of notification, the Architect and the consulting Engineers will perform the inspection and a copy of the report of the inspection shall be furnished to the Contractor so that the Contractor may proceed without delay with any part of the Work found to be incomplete or defective. The Contractor shall complete the items listed within thirty (30) calendar days and notify the Owner and Architect
- C. When the items appearing on the report of inspection have been completed or corrected, the contractor shall so advise the Owner and the Architect. After receipt of this notification, the Owner or the Architect and consulting Engineers shall reinspect and inform the Contractor of any remaining items.

A copy of the report of the final inspection containing all remaining contract exceptions, omissions and incomplections shall be furnished to the Contractor within seven (7) calendar days of notification.

- D. The Contractor shall within fourteen (14) calendar days complete the items listed on the inspection report and provide notification of completion and all remaining contract exception, omissions and incomplections from the Contractor, the Owner and the Architect and consulting Engineers will reinspect the Work to verify completion of the exception items appearing on the report of final inspection.

Upon completion of reinspections, the Architect will prepare a certificate of final acceptance or will furnish to the Contractor a copy of the report of the Architect's reinspection detailing Work that is incomplete or obligations that have been fulfilled but are required for final acceptance.

The Contractor shall compensate the Architect and all consulting Engineers for services performed on Punch List inspections beyond the original inspection and two reinspections of the same area through a credit change order reducing the total contract amount.

- E. Upon Substantial Completion of the Work, the Contractor will be paid all retainage, less one hundred fifty percent (150%) of the value attributable to “punch list” work. As items on the punch list are completed, the Contractor will be paid one hundred fifty percent (150%) of their value at the next progress payment.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01 81 14

ENVIRONMENTAL IMPACT OF MATERIALS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

- A. Objectives: To obtain acceptable Indoor Air Quality (IAQ) for the completed project and minimize the environmental impacts of the construction and operation, the Contractor during the construction phase of this project shall implement the following procedures singly or in combination:
 - 1. Select products that minimize consumption of non-renewable resources, consume reduced amounts of energy and minimize amounts of pollution to produce, and employ recycled and/or recyclable materials. Obtain Architect's approval of all materials listed in Part 2 prior to placing the order with the manufacturer of the material.
 - 2. Maintain a materials log book and verification that materials used have been reviewed for environmental considerations as outlined in this section.
 - 3. Control sources of potential IAQ pollutants by controlled selection of materials and processes used in project construction in order to attain acceptable IAQ as defined in this section.
- B. Products and processes that achieve the above objectives to the extent currently possible and practical have been selected and shown in the Contract Documents. The Contractor is responsible to maintain and support these objectives in developing means and methods for performing the work of this Contract and in proposing product substitutions and/or changes to specified processes.

1.03 RELATED WORK:

- A. Division 1 sections: "Indoor Air Quality Requirements", and "Waste Materials Management and Recycling".

1.04 SUBMITTALS:

- A. Submit the following in accordance with Conditions of the Contract and Division 1 specification sections.
 - 1. Submit as part of the Division 1 Project Closeout documents indicating for each material the VOC content, the recycled content, and the Manufacturer's Safety Data Sheet (MSDS).

1.05 QUALITY ASSURANCE:

- A. As part of the Preconstruction Meeting specified in Division 1 discuss the IAQ and environmental impact compliances required by this Contract. The purpose of this agenda item is to develop a mutual understanding of the IAQ and environmental impact program requirements, and coordination of the Contractor's management of the program with the Architect.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General: The following special IAQ and environmental impact requirements apply to materials specified in their respective technical specification sections of this Project Manual. See Tables 2.1 and 2.2 for definitions of low VOC content and recycled content.

The following list are qualities requested to be attained to the best ability of the Contractor for each of the described materials in the pursuit to achieve a more environmentally compatible building.

- B. Division 04 - Masonry:
1. Concrete Unit Masonry:
 - a. Concrete Unit Masonry shall maximize the use of recycled materials.
 - b. Reinforcing bars shall maximize the use of recycled steel.
- C. Division 05 - Metals:
1. Structural Steel: Framing steel shall maximize the use of recycled steel.
- D. Division 06 - Wood and Plastics: Wood products:
1. Each specified solid and veneer wood species must originate from a sustainably managed forest certified by a Forest Stewardship Council (FSC) accredited certification group such as Smartwood or Scientific Certification Systems (SCS).
 2. Fiberboard used as blocking, millwork, casework substrate, underlay and door cores must be urea-formaldehyde free, and not exceed ANSI A208.1-1993 emission standard of 0.20 ppm of formaldehyde.
 3. Structural fiberboard (OSB, MDF, and particleboard) shall maximize post-consumer waste material.
 4. Transparent wood finish systems shall utilize only waterborne acrylic sealers and finish coats.
- E. Division 07 - Thermal and Moisture Protection:
1. Building Insulation:
 - a. Insulation materials manufactured using chlorofluorocarbons (CFCs) shall not be used. (CFCs have been completely phased out of U. S. manufactured insulation products.)
 - b. Extruded polystyrene insulation shall not be manufactured with chlorofluorocarbon (CFC) blowing agent and shall maximize recycled content.
 - c. Fiberglass batt insulation, fiberglass board insulation, and mineral wool insulation shall maximize use of recycled material.
 - d. Mineral wool fire safing insulation shall maximize recycled material.
 3. Joint Sealants:
 - a. Interior sealants shall not contain: mercury, butyl rubber, neoprene, SBR (styrene butadiene rubber), or nitrile.
 - b. Silicone sealants shall be low VOC content.
 - c. Polyurethane sealants containing mercury shall not be used.
 - d. Compressible foam joint fillers, polyester polyurethane foam impregnated with neoprene rubber or acrylic ester styrene copolymer used in this facility shall not be manufactured with CFC blowing agents.

- e. Sealants formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure) fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, or their components shall not be used.
- F. Division 09 - Finishes:
- 1. Portland Cement Plaster:
 - a. Plaster including additives such as epoxy or other resins shall be low VOC content.
 - b. Steel lath shall maximize recycled steel.
 - 2. Gypsum Drywall:
 - a. Gypsum board must contain recycled or synthetic gypsum. Facing paper shall be manufactured from recycled newsprint including post-consumer waste.
 - b. Glass fiber sound attenuation blanket insulation shall maximize recycled material.
 - c. Joint compound shall be low VOC content.
 - d. Multi-layer gypsum board applications shall be screw attached and not laminated with adhesives.
 - e. Provide for thorough cleaning and removal of all silica/gypsum dust upon completion of gypsum drywall installations, including, but not necessarily limited to, all components in plenum spaces, including tops of pipes and sills, and insides and outsides of ducts (as required in Division 23).
 - f. Only paper joint tape (no fiberglass tape) will be used.
 - g. Mineral fiber sound attenuation blankets shall maximize recovered material.
 - h. Steel studs, runners, and channels for framing shall maximize recycled steel content.
 - 3. Acoustic Panel Ceilings:
 - a. Ceiling panels shall maximize use of recycled material, and be finished with water-based low VOC paint.
 - b. Suspension systems shall maximize recycled material.
 - 4. Paint and Polychromatic Finish Coating:
 - a. Do not use water based paints formulated with aromatic hydrocarbons (organic solvent with a benzene ring in its molecular structure), formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI and their oxides. Water based paints shall be low VOC and shall have a flash point of 61 degrees C or greater.
 - b. Where it is necessary to use solvent-based paints, they shall be formulated for low VOC emissions and shall not be formulated with formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI and their oxides, nor formulated with more than 10% aromatic hydrocarbons by weight.
 - c. The following shall be low VOC and not be formulated with aromatic hydrocarbons (organic solvent with a benzene ring in its molecular structure) formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI and their oxides.
 - High performance water based acrylic coatings.
 - Pigmented acrylic sealers.
 - Catalyzed epoxy coatings.
 - High performance silicone grafted epoxy coatings.
- G. Division 21, 22 & 23 – Fire Protection, Plumbing & Mechanical:
- 1. Basic Mechanical Materials and Methods: Use low VOC joint sealers.

2. Basic Piping Materials and Methods: Use solder that does not contain lead.
3. Underground Utilities - Basic Piping Materials and Methods: Use solder that does not contain lead.
4. Pipes and Pipe Fittings: Use solder that does not contain lead.
5. Mechanical Insulation: Mechanical sound insulation materials within the duct shall include a impervious, non-porous coating that prevents dust from accumulating in the insulating materials.
7. Metal Ductwork: Use low VOC joint and seam sealants.

Table 2.1 Definition of Low VOC Content Levels

<u>Material or Product</u>	<u>Low VOC Content Level</u>
Form Release Agents	350 g/L VOC content
Transparent Wood Finish Systems	350 g/L VOC content
Water based Joint Sealants	50 g/L VOC content
Non-water based Joint Sealants	350 g/L VOC content
Gypsum Drywall Joint Compound	20 g/L VOC content
Acoustic Panel Ceiling Finish	50 g/L VOC content
Water-based Paint & Polychromatic finish coatings	150 g/L VOC content
Solvent -based Paint	380 g/L VOC content
High Performance Silicone	250 g/L VOC content

Table 2.2 Required Minimum Recycled Content of Materials

<u>Material or Product</u>	<u>Recommended Recycle Content</u>
Framing steel	30% recycled steel 1
Fiberglass batt insulation	20% recycled glass cullet 2
Fiberglass board insulation	20% recycled glass cullet 2
Mineral wool insulation	75% recycled material (slag) 2
Mineral wool fire safing insulation	75% recycled material by weight (slag) 2
Gypsum board	10% recycled or synthetic gypsum
Facing paper of Gypsum Board	100% recycled newsprint including post consumer waste 2
Mineral Fiber Sound Attenuation Blankets	75% recovered material by weight (slag) 2
Steel studs, runners, and channels	60% recycled steel 1
Steel doors & frames	20% Pre-consumer & 50% Post-consumer Recycled content
Acoustic Panel Ceilings	60% recycled material by weight
Ceiling Suspension Systems	60% recycled material 1
Structural fiberboard	80-100% recycled content 2

Notes for Table 2.2:

1. 60% represents the average recycled content for the U. S. steel industry. Use of U. S. manufactured steel will meet this requirement.
2. As per EPA Comprehensive Guideline for Procurement of Products Containing Recovered Materials (60 FR 21370, effective May 1, 1996).

PART 3 - EXECUTION

3.01 GENERAL:

- A. Submit to the Architect for review and approval product data such as MSDS and environmental impact data prior to ordering project materials.
- B. Prepare and maintain a Materials Log, providing information on content of materials, where specific materials are to be used, MSDS, and environmental specifications of the material. Maintain the log book weekly as materials are ordered.

3.02 FIELD QUALITY CONTROL:

- A. The Owner reserves the right to take samples and perform, at random, tests of approved materials delivered to the job site to verify compliance of actual materials with specifications.

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SECTION 01 81 22

INDOOR AIR QUALITY MANAGEMENT
DURING CONSTRUCTION

PART 1- GENERAL

1.01 SUMMARY

- A. IAQ Management during Construction
 - 1. Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows:
 - a. During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, latest edition, Chapter 3.
 - b. Protect stored on-site or installed absorptive materials from moisture damage.
 - c. Replace all filtration media immediately prior to occupancy with MERV 8 filters or higher.

1.02 OVERVIEW

- A. The intent of this IAQ Plan is to:
 - 1. Minimize exposure of construction workers to air pollutants;
 - 2. Prevent air pollutants from collecting in building systems and on building materials; and
 - 3. Prevent air pollutants caused by construction from migrating into occupied spaces.
- B. For the purposes of this plan, air pollutants are defined as: Particulates, Volatile organic compounds, Formaldehyde, Combustion emissions, Airborne bacteria and micro-organisms and Airborne inorganic compounds, such as ozone (from electric motors), metal fumes (from smoldering and welding), and ammonia and chlorine (from cleaning products).

PART 2- PRODUCTS

Not used

PART 3-EXECUTION

3.01 HVAC EQUIPMENT AND DUCT WORK

- A. HVAC equipment and ductwork will be protected from dust and other pollutants via the following procedures:
 - 1. Sealing Ductwork and Air Handling Equipment
 - a. Openings into installed or existing ductwork and air-handling equipment not in active use will be sealed using taped plastic, taped cardboard, or other reasonably air-tight coverings. Sealing will occur prior to, or immediately upon installation of the new ductwork or equipment. Regular walk-throughs will be conducted by the Contractor to check for damaged or displaced coverings. Repair or replacement of damaged or displaced coverings will occur immediately upon discovery, at the direction of the Contractor.

- b. Construction work that generates air pollution will be avoided where ductwork or air handling equipment is being installed. If visible air pollutants are present in a space where ductwork is to be installed, spot cleaning or other measures will be used to prevent ductwork or equipment contamination.
- 2. Use of Mechanical Systems during Construction
 - a. Exhaust and makeup air supply systems:
When a system is operated during construction, its filters will be replaced upon completion of construction with MERV 13 filters.
 - b. Air handling systems will be subject to these provisions when operated during construction:
 - 1. The AHU will be protected with a temporary filter having a minimum rating of MERV 8, per ASHRAE 52.2.
 - 2. Distribution elements needing filters, including all return air ductwork, will be protected with temporary filters having a minimum rating of MERV 8 per ASHRAE 52.2 unless otherwise noted below.
 - c. All components of the distribution on the return side will be protected, including but not limited to:
 - 1. The portion of the air handler upstream of the central fan;
 - 2. Return vents, ducts and shafts;
 - 3. VAV box intakes; and
 - 4. Transfer ducts.
 - d. Components of the distribution system on the supply side will typically not need protection except if portions of the supply system become contaminated, coarse filters will be applied to completely cover supply outlets, to prevent the distribution of particulates into building spaces.
- 3. Filter Replacement and Tracking
 - a. MERV 8 filters used for ductwork protection will be replaced on an as-needed basis, as determined by the Contractor.
 - b. Upon completion, the MERV 8 filters used for ductwork protection will be discarded. New filters will be installed at all air handlers.

3.02 TEMPORARY LOCAL EXHAUST

- A. Where available, operable vents and windows will be opened to ventilate the building during application of interior finishes when weather conditions are suitable. Spaces with fixed glazing or no windows will be ventilated by localized temporary exhaust, as described below, or by using building mechanical systems (described above).
 - 1. Local temporary exhaust will be accomplished using fans, duct extensions, and filters.
 - 2. Local temporary exhaust will not discharge near air intakes or other openings that lead into the building.

3.03 COVERING OR SEALING SOURCES OF POLLUTION

- A. The following are rules that apply to materials that emit air pollution or odors:
 - 1. Containers containing wet materials will be covered whenever they are not in active use.
 - 2. Waste materials will be covered or sealed and regularly removed from the building.
 - 3. Absorptive materials or materials with an odor will be covered while moved through the building.
 - 4. Whenever possible, material containers will be disposed of with the covers on.
 - 5. Materials that require a surface coating to control pollutants or odors will be coated promptly.

3.04 CONTROLLING POLLUTION AT ENTRANCES

- A. Measures will be taken to prevent pollutants from being tracked into interior spaces by workers or equipment. These will include temporary walk-off mats and floor protection.

3.05 PROTECTION OF STORED MATERIALS

- A. Measures will be taken to minimize dust accumulation on material surfaces and the absorption of other pollutants by absorbent materials. The measures will include the following:
 - 1. Materials will be handled and stored according to the manufacturer's recommendations.
 - 2. Unwrapped absorbent materials will be shrink-wrapped if necessary.
 - 3. Highly absorbent materials like duct liner, acoustic tile, carpeting, or insulation will be stored indoors in the original packaging, or covered and sealed.
 - 4. Moderately porous materials like gypsum board will be stored indoors, wrapped or away from dust and materials prone to off-gas VOC's.
 - 5. Framing lumber will be stored indoors whenever possible. If stored outdoors, the lumber will be covered with a water proof covering, stored off the ground, and located away from standing water.
 - 6. Dense material like glass, metal framing, ductwork and equipment will be covered and kept dry.
 - 7. If condensation forms on cold material, care will be taken not to expose it to dust or other particles. If exposed to pollution, housekeeping measures will be used promptly to clean the material before installation.

3.06 PREVENTING CONTAMINATION OF COMPLETED AREAS FROM WORK UNDER CONSTRUCTION

- A. When work is completed in an area, the area will be protected from pollutants generated in other parts of the building still under construction. One or more of the following methods of pathway interruption will be used:
 - 1. Erecting barriers between completed areas and areas still under construction
 - 2. Where present, doors and windows will be closed and locked between completed portions of the building and portions of the building still under construction.

3.07 HOUSEKEEPING

- A. The following housekeeping measures will be employed throughout construction:
 - 1. A regular housekeeping schedule will be instituted. Cleaning measures and frequency will be selected according to the pollutants generated in a space.
 - 2. Low-odor cleaning agents will be used.
 - 3. Spills of water or solvent will be cleaned up immediately.
 - 4. Attention will be given to cleaning hidden or hard-to-reach surfaces, such as wall cavities, tops of door, ledges, and behind water closets.

3.08 SCHEDULING

- A. Construction activities shall be scheduled such that construction and occupancy do not overlap in time. Provide adequate time for carpet, paint and other finishes time to off-gas prior to occupancy.

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SECTION 01 91 13

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section presents general commissioning requirements for the Museum of Natural History at Roger Williams Park HVAC Renovations project to be met in addition to specific commissioning requirements for work on the commissioned systems in Division 23.
- B. The Owner requires participation in comprehensive commissioning of selected systems, assemblies, and components. This section includes general requirements that apply to all commissioned systems, assemblies, or components. Additional specific requirements are found in Division 23.
- C. All requirements on drawings and in the general provisions of the Contract, including but not limited to the Agreement and General Conditions, apply to this Section.

1.2 ABBREVIATIONS AND DEFINITIONS

- A. BOD: Basis of Design. A document that records concepts, calculations, decisions, operational performance criteria and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of specific items required to meet the Owner's Project Requirements.
- B. Commissioning Authority: The reviewing entity employed directly by the Owner to verify that the Owner's Project Requirements are met, and to assist the Owner by providing quality improvement services.
- C. Commissioning Issues Log: The primary document for recording and communicating issues identified through the commissioning process.
- D. DB: Design/Build Team - The Design/Build entity designing and constructing the project to the requirements of the documents and the approved detailed designs and permit sets, including Consultants and their Sub-Consultants, and Trade, Tier and Sub- Contractors.
- E. Design Professional: The design professional or professionals of record responsible for sealing the construction documents, permit applications and for consultations with the authority having jurisdiction at various stages of plan review and construction. While these professionals are part of the Design/Build Team, they are referred to separately when they perform distinct functions with respect to commissioning, such as considering commissioning comments during formal review of product data and other submittals.
- F. FPT: Functional Performance Testing, including testing of individual components, entire systems, and intersystem performance.
- G. O&M: Operations and Maintenance.

- H. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. The commissioning process verifies and documents whether the final built commissioned systems in the project meet the OPR.
- I. PFC: Pre-Functional Checklists developed by the commissioning agent for completion by Trade Contractors.
- J. Submittals: Documents required by the contract documents including product data and other formal submittals.
- K. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- L. Systems Checklists: Checklists developed and completed by the commissioning agent
- M. TAB: Test, Adjust and Balance.
- N. Trade Contractors: Trade contractors, sub-contractors, tier contractors, direct equipment suppliers and their representatives, testing firms, and Test, Adjust, and Balancing firms.

1.3 COMMISSIONING PROCESS

- A. **NOTE: For this project, the Contractor is required to hire a third party commissioning company to perform all equipment commissioning. The Owner and Architect are to review the third party company for approval prior to the commencement of any testing.**
- B. The commissioning process, including Functional Performance Tests, is separate from and does not reduce or replace the requirements of the formal acceptance process by the Owner and Design Professional or the requirements of the authorities having jurisdiction. The third party company will accept documented testing performed as part of the formal acceptance process that is witnessed by the Owner, Design Professional or the authorities having jurisdiction in order to avoid duplicate testing where possible.

C. Sampling

1. Generally, representative samples of the work will be periodically verified by the commissioning company as an indicator of the quality of the work.
2. This sampling method will be used as a quality check for equipment, piping, redline or record drawings, etc. The intent is that commissioning verification occurs when each aspect of commissioned work first begins, so that any resulting changes required are made after only a small portion of the work is put in place, not all of it.

D. Problem Solving

1. The commissioning agent will suggest solutions to issues but does not assume the burden of responsibility to solve and correct issues that are found.

E. Communication During Construction Phase

1. Coordination of Trade Contractor participation in the commissioning team is through the DB. Comments, observations, etc. resulting from commissioning activities will be recorded in the Commissioning Issues Log and relayed directly to the responsible party whenever possible, with copies to the Owner, Design Professional and DB, as applicable. This includes submittal comments, site observation reports, test reports, etc. This direct communication approach is intended to avoid delays from traditional remote paper exchanges, will encourage dialogue and discussion of options and alternatives, and generally maintain an atmosphere of cooperation and quality.
2. The commissioning agent is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management.
3. The commissioning agent may assist with problem solving, non-conformance or deficiencies, but ultimately that responsibility resides with the DB.
4. The primary role of the commissioning agent is to develop and coordinate the execution of the commissioning plan including testing, to observe and document performance, and to document whether systems are functioning in accordance with the documented Owner's Project Requirements.
5. The commissioning agent does not direct or redirect the DB or the Trade Contractors in their contracted work, and no communication shall be construed as such direction.
6. The commissioning agent is not authorized to:
 - a. Release, revoke, alter or expand requirements of Contract Documents.
 - b. Approve or accept any portion of the work.
 - c. Perform any duties of the DB, its consultants, or its contractors.

F. Response Times

1. Timeliness in delivering information or forming responses to the commissioning agent, and back, are essential to providing the built project to the Owner on time, as well as to implementing commissioning.

2. The following are guidelines established to meet this objective and should be followed unless there are extenuating circumstances – in which case the delay shall be explained to each party in advance of the delay. Failure to avoid delays means that the delayed work product may not be incorporated into the commissioning reporting process, requiring a separate resolution process with the Owner without commissioning assistance.
 - a. Construction schedule by the DB incorporating separate activities for commissioning activities, as a minimum including pre-functional checklists, equipment start-ups, controls completion, TAB, and functional performance testing.
 - 1) Within 10 business days after award of Division 23 work.
 - b. Project-specific comments from the commissioning agent on how commissioning activities and dates are incorporated into the schedule:
 - 1) Within 10 business days after receiving component schedule for Division 23 work and updates throughout project.
 - c. Submittal comments by Commissioning agent:
 - 1) 7 business days from date of receipt by Commissioning agent for typical product submittals; 15 business days for Controls, TAB, energy recovery equipment, and other selected complex submittal packages. The commissioning agent will identify other selected complex submittal packages in advance if provided with the submittal register.
 - 2) For this paragraph's purposes, "receive" means electronic or hard copy in the hands of the commissioning agent
 - d. Approved submittals to the commissioning agent:
 - 1) Within 5 business days of receipt by DB.
 - e. Commissioning checklists by the commissioning agent to DB:
 - 1) 10 business days before scheduled delivery of commissioned equipment, provided that the schedule and the approved submittals have been provided to the commissioning agent 20 business days in advance.
 - f. Delivery of draft O&M manuals for the commissioning agent to review:
 - 1) 30 business days after approved submittals.
 - g. Delivery of final O&M manuals and training materials to the commissioning agent:
 - 1) 10 business days prior to each scheduled owner training session.
 - h. Delivery of record drawings marked to as-built conditions to the commissioning agent:
 - 1) Prior to each scheduled training session.
 - i. Delivery of final as-built drawings to the commissioning agent:
 - 1) Within 20 business days of start of warranty period(s).
 - j. Commissioning Issues Log entries by the commissioning agent:
 - 1) Within 5 business days after observation.
 - k. Response by DB and Trade Contractor to commissioning Issues Log entries and field comments:
 - 1) 5 business days after receipt of Issues Log where other parties are not involved, or at the next commissioning meeting.

1. Delivery of functional performance testing procedures by Commissioning agent to DB:
 - 1) 20 business days before scheduled testing provided that schedule and draft O&M manuals have been provided to the commissioning agent at least 40 business days in advance of scheduled testing.

1.4 DB AND TRADE CONTRACTOR REQUIREMENTS

A. DB

1. The DB's responsibility for construction safety is unaffected by this section.
2. The DB's responsibility for the quality of the installed work is unaffected by this section.
3. The DB shall establish at least one contact person, plus alternates where appropriate, for each trade or system involved in the commissioning process. This requirement facilitates effective communication during commissioning.
4. The DB shall communicate to the commissioning team the construction schedules, milestones, completion schedules, planned testing, etc., including updates. The DB shall incorporate commissioning activities closely tied to the construction activities into the project schedule as agreed by the DB, the Owner, and the commissioning agent
5. The commissioning agent has no authority to change the contract or direct the DB in any of their work, only to provide comments and suggestions. Any issues that the commissioning agent identifies that cannot be resolved with the DB and the Trade Contractors will be jointly presented to the Owner for resolution.
6. As each commissioning issue is identified, the DB shall consider it with the Trade Contractors and respond to the commissioning agent. The DB shall cooperate in resolving commissioning issues that are within the project scope.
7. The DB shall ensure that each required Trade Contractor and direct Supplier participates and cooperates in commissioning, and provides information, assistance, and responses within the time frames in this section.
8. The DB shall ensure that each required trade supports integrated testing and commissioning of inter-related work.
9. Warranty
 - a. The DB shall provide a summary of warranty items as specified, delineated by specification section number, title, and description. The commissioning agent will use this as part of the commissioning comparison and verification of warranty items. This step is intended to assure the Owner that the intended warranty protection will be provided.
 - b. For each warranty item, include the date when the warranty is to begin, the duration of the warranty, and Owner's obligations to maintain to protect warranty.

10. The DB shall schedule in advance and coordinate execution of seasonal or deferred commissioning testing by the Trade Contractors, which shall be witnessed by the commissioning agent. The DB and the Trade Contractors shall correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in seasonal testing.

B. Trade Contractors

1. The Trade Contractors' responsibility for construction safety in their work is unaffected by this section.
2. The Trade Contractors' responsibility for the quality of their installed work is unaffected by this section.
3. The Trade Contractors for commissioned systems and related work will be required to perform certain tasks to assist in the commissioning process. These tasks are described in this section and the commissioning section of each Division that includes commissioned systems.
4. The responsibility for safe operation of components, equipment, and systems during commissioning testing rests with the Trade Contractors.
5. The commissioning agent has no authority to change the contract or direct the Trade Contractors in any of their work, only to provide comments and suggestions. Any issues that the commissioning agent cannot resolve with the DB and the Trade Contractors will be jointly presented to the Owner for resolution.
6. As each commissioning issue is identified, the Trade Contractors shall, with the DB, consider the issue and respond to the commissioning agent. Trade Contractors shall cooperate in the resolution of commissioning issues that are within their contracted scope.
7. PFCs to verify components and work will be provided by the commissioning agent for completion on-site by Trade Contractors, preferably by the person performing the work. PFCs shall be completed as the work progresses.
8. FPT procedures will be developed and led by the commissioning agent and performed by the Trade Contractors on each commissioned system.
9. Inter-related work is subject to integrated inter-system functional performance testing and participation of each related trade is required. This includes seasonal performance testing.

1.5 INCLUDED SYSTEMS

- A. The commissioning agent will develop Pre-Functional Checklists (PFC) that are completed by the Trade Contractors and Functional Performance Tests (FPT) that are executed by the Trade Contractors with the commissioning agent. The installing contractors must complete Pre-Functional Checklists developed by the commissioning agent for components and systems listed; no sampling is allowed. Installing contractors are required to participate in all Functional Performance Testing.

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

- A. Standard testing equipment required to perform startup, initial checkout, and required testing shall be provided by the Contractor, and shall remain the property of the Contractor.
- B. System-specific test equipment, tools and instruments (e.g. test equipment specific to a piece of equipment) required shall be included in the base bid price by the Contractor.
- C. Equipment and software provided by the commissioning agent to test equipment shall not become the property of the Owner.
- D. Testing equipment shall be of sufficient quality and accuracy to measure system performance with the tolerances listed in the system or product specifications.
- E. Calibration tags shall be affixed or certificates readily available. Equipment shall be calibrated according to the manufacturer's recommended intervals, recalibrated when dropped, and repaired and recalibrated when damaged.

PART 3 - EXECUTION

3.1 COMMISSIONING TEAM

- A. The DB, including Designers, and each Trade Contractor performing work on commissioned systems or equipment shall designate personnel to the commissioning team. Such personnel, including knowledgeable sub-contractors or equipment suppliers, shall be responsible for coordinating commissioning activities with the commissioning agent and attending meetings.

3.2 DB RESPONSIBILITIES

- A. The Commissioning Personnel for the DB and each Trade Contractor and equipment supplier for commissioned systems or equipment shall have expertise and authority to act on their firm's behalf and shall be scheduled to participate in and perform commissioning activities including, but not limited to:
 - 1. Cooperate with the commissioning agent for resolution of issues recorded in the Issues Log.

2. Attend commissioning team meetings. Trade Contractors for commissioned systems to attend each commissioning meeting.
3. Integrate and coordinate commissioning process activities into the construction schedule.
4. Review and complete component pre-functional checklists provided by the commissioning agent.
5. Consider and respond to commissioning issues in the Issues Log, which shall be the central communication and record for the commissioning team's efforts and progress.
6. Review commissioning process test procedures provided by the commissioning agent
7. Prepare and pre-check components and systems to ensure successful functional performance testing.
8. Execute commissioning functional performance test procedures.
9. Evaluate performance issues identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
10. In the event retesting is required, pre-check components and systems to ensure successful re-testing. The commissioning agent provides effort for initial and final testing. The DB and Trade Contractors shall provide the efforts required to ensure that subsequent additional re-testing is not required.

3.3 COMMISSIONING MEETINGS

- A. Commissioning meetings including one Construction Phase kick-off meeting will be held throughout the construction period and will be a separate meeting series, not as part of another meeting such as Owner, Design Professional, DB or OAC Meetings, Coordination Meetings, etc.). Commissioning activities and issues will be handled during these regularly scheduled commissioning meetings.
- B. At least one (1) representative from the DB and each Trade Contractor of the systems being commissioned shall participate in scheduled construction phase commissioning activities. These persons should be prepared and qualified to discuss system items relevant to commissioning.
- C. Commissioning meetings will be held quarterly during demolition and rough-ins, monthly until system start-up, biweekly during system start-up, and weekly during functional performance testing, and as required by the Owner to resolve issues after move-in.

3.4 SUBMITTALS

- A. The DB and the Trade Contractors shall provide a submittal log from which the commissioning agent will determine what system/component submittals should be forwarded to the commissioning agent

for review in addition to the copies sent to the Design Professional. The commissioning agent will review selected submittals with respect to the Owner's Project Requirements.

1. The DB and the Trade Contractors will coordinate and execute a submittal review process that results in formal submittal actions and records for each component of each commissioned system in advance of delivery of each component to the project site.
- B. Submittals shall show evidence that they have been reviewed and approved for submittal by the DB and the Trade Contractors prior to circulation to the Owner, Commissioning agent, the Design Professionals, and others for review or action. The DB's and the Trade Contractors' pre-review shall include a technical review of the material compared to the drawings and specifications, by persons familiar with that field. Submittals that do not meet the specifications are to be corrected prior to sending to the commissioning agent for review.
- C. Submittals for products that are a substitution shall be clearly indicated on the cover page.
- D. Submittals shall be marked to show exact items, sizes, components, electrical characteristics, operating characteristics, details required for this project, service clearances, and shall be annotated to match drawing schedules.
 1. Product data sheets not showing clearly marked the individual specific type, model, and options intended for use on the project will be returned by the commissioning agent as not suitable for further review until revised.
- E. Catalog information which makes reference to several options, variations, sizes, etc. shall be clearly marked (arrow, underline, circled, etc.) to indicate exactly the intended item. Generic cut sheets are not acceptable.
- F. Provide Manufacturers' detailed installation requirements clearly marked (arrow, underline, circled, etc.) to exactly indicate the intended item.
- G. Provide Manufacturers' detailed start-up requirements and procedures clearly marked (arrow, underline, circled, etc.) to indicate only the intended item.
- H. Provide Manufacturers' operation instructions clearly marked (arrow, underline, circled, etc.) to indicate only the intended item.
- I. Provide Manufacturers' recommended maintenance and troubleshooting procedures clearly marked (arrow, underline, circled, etc.) to indicate only the intended item.
- J. Provide Warranty and clear statement of the Owner's obligations to maintain equipment to preserve warranty.
- K. Product data submittals for any OEM Variable Speed Drives shall include details of compliance with the Owner's standards for VFDs.
- L. The commissioning agent shall be provided commissioning-related submittals for review in parallel with the Design Professional review. The focus of this commissioning review will be to:
 1. Verify that the equipment or system meets the Owner's Project Requirements.

2. Verify that equipment or system includes provisions and accessories for access, maintenance, start-up and functional performance testing.
- M. The commissioning agent will forward review comments to the Owner with copies sent simultaneously to the Design Professional. The Design Professional will select which of these commissioning comments are appropriate to incorporate in their submittal actions.
- O. Training Agendas, O&Ms, As-Built, information for the Owner-required Building Equipment Data Sheets in spreadsheet format, and BAS programming files shall be provided as formal submittals.

3.5 PRE-FUNCTIONAL CHECKLISTS

- A. The intent of the commissioning pre-functional checklists is to detect and reduce or eliminate problems in delivery and installation.
- B. The commissioning agent will produce Pre-Functional Checklists for certain commissioned components.
 1. Upon receipt of comments, the commissioning agent will modify checklists to address the DB and Trade Contractors comments, as applicable. Where inconsistencies occur between the PFCs and the contract documents, the contract documents take precedence.
 2. The commissioning agent will develop component-based Pre-Functional Checklists and provide the DB with all PFCs (for individual Trade Contractors responsible) for use on the jobsite.
 3. Each installing contractor's personnel actually performing the installation work is responsible for completing that trade's checklist for each component.
- C. Timely completion of checklists is required within two business days of completing the related work.
- D. Each Contractor is responsible for accessing or downloading checklists from the DB, completing them, and returning them electronically to the DB.
- E. The DB is responsible for managing and checking the checklists for timely, accurate completion.
- F. The commissioning agent will provide the DB and Trade Contractors with training on the checklist process. The commissioning agent will review the checklist for each type of equipment with the respective Trade Contractor(s) prior to installation of the equipment to ensure the Trade Contractors understand the checklist process and the specific items on the checklists.
- G. The completion of the component checklist does not eliminate the DB and Trade Contractors responsibility for meeting other requirements in the specifications and drawings.
- H. The commissioning agent will periodically verify the accuracy, completeness and

tracking of the component checklists. If persistent errors are found, the responsible Trade Contractor shall re-validate 100% of the component checklists for the problem equipment or system type.

3.6 O&M MANUALS

A. General

1. O&M manuals in electronic format shall be submitted to the commissioning agent for review in addition to the other parties.
2. The commissioning agent will provide their review comments to the Design Professional, who will select which of these commissioning comments are appropriate to incorporate in their submittal actions.
3. The DB and Trade Contractors shall make changes to the O&M manual based on the comments of the Design Professional and Owner.
4. After delivering final copies of O&M manuals to the Owner, confirm in writing the person who took delivery of the manuals and the date and time they were received.

B. Content

1. Include in the O&M Manuals all information required elsewhere, but not less than the following:
 - a. A one-page informational sheet with:
 - 1) Tag number or system name
 - 2) Location / room number
 - 3) Manufacturer, model number, serial number, and other informational data listed on the nameplate
 - 4) Name, address, and telephone number of installing Contractor and equipment vendor
 - 5) Names, telephone numbers, and URL (internet address) of sources of service and repair parts
 - 6) Date of installation and of start-up
 - 7) Operational and performance data per installed conditions
 - 8) Setpoints at time of start-up
 - b. A copy of equipment specifications
 - c. A copy of the approved submittal (and/or RFI or change order if applicable)
 - d. Manufacturer's installation, operation, and maintenance manuals, including:
 - 1) Installation instructions
 - 2) Operation instructions, including start-up, break-in, shutdown, seasonal, emergency, and special operation procedures
 - 3) Maintenance instructions, including intervals, procedures and instructions for problem corrections, preventive maintenance, testing, alignment, adjustment, and repair
 - 4) Removal and replacement instructions, including removal, replacement, disassembly, and assembly instructions, including any specific tools required, required tolerances, settings, or adjustments

- 5) Troubleshooting and diagnostic procedures, including troubleshooting and diagnostic procedures for common component malfunctions and the tools required for these procedures
 - e. Manufacturer's recommended preventive maintenance tasks for the component in a timeline fashion. Includes:
 - 1) Preventive maintenance task
 - 2) Procedure for the task
 - 3) Special tools and instruments required for the task
 - 4) Frequency of the task
 - f. Inspection and testing reports, including all documentation related to the start-up, balancing, and certification of the component
 - g. Maintenance records, indicating maintenance performed by the DB and Trade Contractors prior to operation of the component being turned over to the Owner
 - h. A copy of the warranty, including the covered items, date of inception, and date of expiration
 - i. A single page document listing any special tools or testing equipment required for the operation, testing, or maintenance of the component
 - j. The sequence of operation and control diagrams for components controlled by the building automation system, or other commissioned controls
 - k. Wiring diagrams
- C. Electronic O&M Manual Edits and Mark-Ups
- 1. O&M manual data should be edited and marked up to clearly indicate which products, model numbers, accessories, and options were provided with the equipment for this project.
 - 2. The O&M manual shall be organized by system, equipment type, and component name (tag number).
- D. Electronic O&M Manual Format
- 1. If a paper O&M Manual is also submitted, the electronic O&M should be labeled and organized so that all its sections appear in the same order in both versions.
 - 2. All documents shall be submitted in standard formats acceptable to the Owner.
 - 3. All electronic O&M data is to be delivered on CDs or DVD-ROM disks that are formatted for reading from a standard drive.
 - 4. CDs are to be contained in durable plastic cases.
 - 5. The CDs or DVD-ROM disks shall be labeled permanently in legible ink with the project name, "OPERATION AND MAINTENANCE MANUAL – VOLUME _ OF _" and a description of the contents, e.g., which systems are contained on the CD or DVD-ROM disks.
 - 6. The O&M data shall be organized by the following naming structure for the electronic files:

- a. (Equipment Type Name)_(DOCUMENT TYPE IN CAPS).(file extension)
 - b. Example: a manufacturer's O&M manual for air handling unit AHU-1 would be named: AHU-1_OM.pdf.
 - c. Example: a chilled water piping submittal would be named CHW Pipe_SUB.pdf.
 - d. The following are additional examples of documentation type abbreviations:
 - 1) O&M Manual: OM
 - 2) Installation Instructions: INSTL
 - 3) Submittal: SUB
 - 4) Specification Section: SPEC
 - 5) Change Order: CO
 - 6) Sequence Of Operation: SOO
 - 7) Control Diagrams: CRTLD
 - 8) Preventive Maintenance Instructions: PM
 - 9) Warranty: WTY
 - 10) Parts List: PL
 - 11) Tools List: TL
 - 12) Inspection/Test Reports: ITR
 - 13) Maintenance Records: MR
 - 14) Spare Parts List: SPL
 - 15) Wiring Diagrams: WD
7. The files on each CD or DVD-ROM disk should be organized by system according to the following folder structure:
- a. System name (e.g., Chilled Water System)
 - 1) Component Type / System Type (e.g., pumps, chilled water piping)
 - 2) Tag number or system name (e.g., Pump P-1, chilled water piping)
 - 3) For numerous, repetitive equipment such as terminal units, the O&M documentation does not need to be separated by tag number. Rather, similar types of the equipment (e.g., fan powered with reheat, fan powered without reheat, etc.) can be grouped into one file and a table provided to document the tag numbers, model numbers, and capacity/performance data.
8. Where more than one CD or DVD-ROM disk is required, do not split the documentation for a system apart and include parts on two different CDs or DVD-ROM disks.
9. All documentation provided shall be clearly marked to indicate the installation for the present project. Unedited general cut sheets and manuals for multiple models, installations, etc. are not acceptable.

3.7 EQUIPMENT START-UP

- A. The DB will coordinate start-up of commissioned systems and equipment by the Trade Contractors, and provide at least two working days notice to the commissioning agent

- B. The commissioning agent will witness selected start-up of commissioned systems and equipment for compliance with the Owner's Project Requirements.
- C. For all commissioned systems and equipment, one copy of the start-up report shall be forwarded to the commissioning agent for review and to document that the equipment is installed, operational, and ready for commissioning testing.

3.8 COMMISSIONING FUNCTIONAL PERFORMANCE TESTING

- A. All Pre-Functional Checklists, start-ups, adjustments, controls programming, verification of proper operation, and the Contractor's Affidavit of Readiness for Testing Commissioned Systems shall be completed by the Contractors prior to Functional Performance Testing.
 - 1. For the Contractor's Affidavit of Readiness for Testing Commissioned Systems, The commissioning agent provides the contractor with a blank affidavit document that allows the contractor to confirm and document that all required testing prerequisite documentation has been completed and that the commissioned systems have been completely installed and are ready for testing by the commissioning agent. If the commissioning agent, with the project team, determines that a phased testing approach may be appropriate, several affidavit documents may be prepared for a phased approach to testing the commissioned equipment.
 - 2. While components can be tested as work is completed, system functional performance testing requires completion of all testing prerequisites: checklists, start-up, start-up forms, controls point-to-point checks, controls sequences programming and debugging, TAB, and other contractual requirements.
- B. In general, Functional Performance Testing shall include testing each sequence in the sequence of operations, and other significant modes, sequences and control strategies not mentioned in the written sequences; including, but not limited to startup, shutdown, unoccupied and manual modes, modulation up and down the unit's range of capacity, power failure, alarms, component staging and backup upon failure, interlocks with other equipment, and sensor and actuator calibrations.
 - 1. All interlocks and interactions between systems shall be tested.
 - 2. All larger equipment will be individually tested.
 - 3. Like units or assemblies that are numerous (many smaller rooftop packaged units, air terminal units, exhaust fans, windows, etc.) may have an appropriate sampling strategy applied.
 - 4. Heating equipment must be tested appropriately during winter and air conditioning equipment must be tested appropriately during summer to demonstrate performance under near-design conditions.
- C. Perform Functional Performance Tests as developed and led by the commissioning agent with the commissioning team.
 - 1. The commissioning agent will provide draft Functional Performance Test procedures for review by the commissioning team members. The commissioning agent will incorporate any comments received into revised procedures. No response within five business days indicates approval.

2. The contractors will provide all tools or the use of tools to start, access equipment, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the commissioning agent
- D. If major problems are discovered during any test (i.e. problems that will delay the completion of the test), the DB, with the responsible Trade Contractors, will fix the problem after the conclusion of testing. When the DB and Trade Contractors have resolved the problem, testing shall be rescheduled and redone. If the issue is still not resolved, the General Contractor is responsible for all additional costs for additional retesting.
- E. Any required retesting shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- F. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the testing procedures. As tests progress and an issue is identified, the commissioning agent will discuss the issue with the appropriate Trade Contractor who is performing the test to determine how to proceed.
 1. Corrections of minor issues identified may be made during testing at the discretion of The commissioning agent. In such cases the issue and resolution will be documented on the test procedure form.
 2. Major issues shall be corrected after the completion of testing. In such cases the issue and the DB and Trade Contractors proposed resolution will be documented on the test procedure form. Upon re-testing, the actual resolution will be documented.
- H. Seasonal Commissioning Tests
 1. Portions of the final commissioning test procedures including but not limited to FPTs will be seasonally dependent (e.g., cooling system needs to be tested in late spring, summer, or early fall) and will need to be performed at a different time of year than the rest of the final commissioning testing.
- I. During on-site functional performance testing, basic COVID-19 safety protocols will be strictly adhered to. Failure of any building occupants to comply with these protocols during the on-site functional performance testing will result in a failed testing attempt and deducted from the total number of testing attempts allocated for the project.

3.9 SITE OBSERVATIONS AND VERIFICATION

- A. The Commissioning Authority will periodically visit the site to observe the work in progress. Observations and recommended corrective measures will be tracked in the commissioning issues log and communicated to the DB and Owner.
- B. Any commissioning observation that does not meet the Owner's Project Requirements is a commissioning issue and will be included in the Commissioning Issues Log or other reports as appropriate. Each observation is intended to improve the project quality and achieve the Owner's Project Requirements.
- C. During site visits, basic COVID-19 safety protocols will be strictly adhered to. Failure of any building occupants to comply with these protocols during the site visits will result in a failed site visit and deducted from the total number of site visits allocated for the project.

3.10 DOCUMENTATION OF COMMISSIONING ISSUES

- A. The Commissioning Issues Log focuses on systemic issues and is not a complete “punch list” containing all occurrences of the issue, i.e., all pieces of the equipment type mentioned in the issue may not have been individually verified.
- B. The DB shall respond to the Commissioning Authority and PM at least as often as commissioning meetings are being scheduled concerning the status of each outstanding issue identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 - 1. If issues remain open for more than two commissioning meetings without steps taken toward resolution or without a plan communicated for resolving the issue, the commissioning agent may request, and the DB shall provide, a response in writing including explanations of any disagreements and proposals for their resolution.
- C. To aid in issue resolution, any commissioning issues identified during commissioning testing will be noted in the Issues Log.
- D. If the commissioning team cannot reach a resolution to an issue or disagree on whether an item should be an issue, the commissioning agent and the DB will present the issue jointly to the Owner for direction.

3.11 TRAINING

- A. General
 - 1. The DB, with input from the Owner, shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
 - 2. The commissioning agent will verify that the DB provides the training schedule in advance to the Owner.
 - 3. The Trade Contractor for the respective system is responsible for the development and implementation of the training material for the system.
 - 4. Training shall be completed and accepted by the Owner prior to occupancy.
- B. Scope of Training
 - 1. The DB shall provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment.
 - 2. The training topics shall include all equipment and systems. The DB shall provide training on each piece of equipment. Training syllabus shall include a breakdown of the time allotted for each system.
 - 3. Training shall include hands-on training on each piece of equipment, which shall illustrate all modes of operation, including startup, shutdown, emergency, power failure, seasonal changeovers, etc.
 - 4. Training topics shall include safety, proper operating requirements, preventative maintenance, special tools needed, recommended spare parts, common troubleshooting problems and solutions, and any equipment or system peculiarities.

C. Preparation for Training

1. Training agenda forms shall be prepared by the relevant Trade Contractors. The agenda shall be followed to assure efficient training and a knowledge level that meets or exceeds the Owner's intent.
2. Training materials and O&M manuals must be submitted to the commissioning agent 5 calendar days prior to each training session.
3. The commissioning agent will review the proposed training material from the DB and the Trade Contractors and will provide comments and suggestions to supplement the training material for operations and maintenance personnel, if and where appropriate.
4. The DB and Trade Contractors training material shall include:
 - a. Detailed agenda
 - b. Trade Contractor contact sheet, including address, phone number, fax number and e-mail.
 - c. Detailed training material, divided by sections.
 - d. Maintenance checklists/ log sheets.

D. Implementation of Training

1. The trainer, prior to and during each training session, shall complete the prepared training record form. The trainer is responsible for checking the subjects covered from the training agenda and for obtaining signatures from the trainees in attendance.
2. All trainers shall have an in-depth working knowledge of the specific installation or system to be covered.
3. All trainers shall be in place, set up, and ready to provide training as scheduled for each training session.

E. Prior to the end of the DB and Trade Contractors warranty period (typically the ninth or tenth month for a one year warranty), The commissioning agent will review operational issues reported by the Owner's operation and maintenance personnel and building users, to help determine if there are any operational problems which have construction or manufacturer's deficiencies as their root cause. If any such problems are identified, the commissioning agent will work with the Contractor to identify a recommended course of action to correct the deficiencies. The contractual responsibility of the subcontractor or supplier to remedy the problem shall not be diminished by the commissioning agent's cooperation.

F. Any resolutions to warranty issues shall be incorporated as changes to as-built, O&M and other required documentation.

3.12 AS-BUILT DRAWINGS

- A. Redline or record drawings shall be kept up to date at all times.
- B. The DB shall ensure that accurate red-line or record drawings of as-built conditions are maintained by each trade, at the job site, throughout the construction phase. The record drawings shall be available for review by the commissioning agent. If discrepancies are noted on the Trade Contractor's record drawings, the DB will review the Trade Contractors' recording procedures and adjustments to ensure that the record drawings are kept up to date and accurate. The record drawings shall be corrected promptly to ensure the accuracy of the

as-built drawings throughout the project.

- C. The redline or record drawings maintained by the Trade Contractors will be periodically reviewed and verified during construction by the commissioning agent. Discrepancies in the drawings will be documented and the Trade Contractors shall verify the as-built drawings against the installed system for all similar problems for correction.
- D. As-built drawings in compliance with the Owner's requirements for electronic drawings shall be formally submitted, and provided to the commissioning agent for review, within 30 days of training.

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

- A. Related Documents:
The Drawings and general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 Requirements, apply to the work in this Section.

1.02 SECTION INCLUDES

- A. All material, labor and equipment required for demolition and removal of existing structures and items as shown on the drawings and as may be required to permit the proper installation of any new work.

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with all applicable local and state Codes.

1.04 SEQUENCING

- A. Coordinate with the occupancy of the owner under provisions of Section 01 10 00.
- B. Avoid interference with the use of and passage to and from adjacent buildings and facilities.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 PREPARATION

- A. Inspection
 - 1. The contractor shall inspect the entire site, premises and all objects designated to be removed and those to be preserved.
 - 2. Locate all existing utility lines and determine the requirements for their protection or abandonment.
- B. Notification
 - 1. Notify the owner at least two full working days prior to commencing the work of this section.
- C. Verification

1. Prior to commencing the work of this section, verify with the owner and the Architect all objects to be removed and all objects to be preserved.

D. Protection

1. Protect all objects and utilities designated to remain as required. Active utilities shall not be interrupted.
2. Provide shoring and bracing for the support of existing structures, that are to remain in place, where necessary to prevent collapse of structures.
3. Dust control shall be as necessary to prevent the spread of dust and flying particles during performance of the work of this section. Provide taped fire resistant polyethylene dust barriers as required. Thoroughly moisten all surfaces as required. Protect HVAC systems from absorbing excessive amounts of contaminants.
4. The contractor shall be responsible to repair or replace all items designated to remain that are damaged due the surrounding demolition.

3.02 CLEANING

- A. Clean work under provisions of Section 01 70 00.
- B. Remove all debris and trash from the site on a daily basis and dispose of in accordance with all local and state Codes.
- C. All removed items scheduled to be retained shall be given to the owner for their use.
- D. Burning at the site will not be permitted.

3.03 SCHEDULE

A. Site Work

1. Remove all concrete equipment pads, sidewalks and bituminous paving indicated on the plans or as required by new construction. Remove all foundations and structures indicated to be removed.
2. Sawcut pavement where existing pavement is to butt against new pavement.
3. Assume that all concrete work is reinforced. Cut or burn reinforcing flush with concrete scheduled to remain.
4. Prior to starting site work, locate, disconnect and cap all utility services designated to be removed. Locate and protect all utility services designated to remain. All work shall be performed in accordance with the requirements of the utility company or agency involved.

B. Finishes

1. Remove all existing floor finishes, base materials and adhesives in all areas scheduled to receive new finishes unless instructed otherwise. Patch and repair all substrate damaged by removal as required to install new finish.
2. Remove all finishes as indicated on the drawings and as required by new construction. Repair or replace substrate damaged by removals.

C. Gypsum Board Partitions

1. Remove partitions, blocking, and associated framing indicated to be removed on the drawings and as required by new construction.
2. Remove all appurtenances, equipment and fixtures from partitions to be demolished.
3. Remove all nails, screws and other fastening hardware associated with partitions to be demolished.
4. Remove all doors, windows and frames within partition to be demolished.

D. Concrete

1. Assume all concrete is reinforced.
2. Use a saw cut on all concrete to be removed that butts concrete to remain
3. Always remove concrete in small sections
4. Provide core boring through concrete floors and roofs as required to install new utilities.
5. Remove all concrete slabs, walls or foundations as indicated on the drawings.

E. Masonry

1. Assume all masonry is reinforced.
2. Remove all masonry as indicated on the drawings and as required by new construction
3. All new openings in existing walls will be saw cut.
4. Saw cut masonry walls as required to install new flashing as indicated on the drawings.
5. Remove reinforcing flush with surfaces scheduled to remain.
6. Remove steel lintels within walls to be demolished.
7. Provide core boring through masonry walls as required to install new utilities.
8. Remove all appurtenances, equipment and fixtures from masonry partitions to be demolished.

F. Structural Steel

1. Remove all structural steel as indicated on the drawings and as required by new construction.
2. Remove all appurtenances and fasteners from the steel being demolished.

G. Doors, Windows and Louvers

1. Remove all doors, frames, hardware, fasteners, sub frame material and anchors from openings indicated on the plans or as required by new construction.
2. Remove window, sub frame materials, and other related items indicated on the plans or as required by new construction.
3. Remove louvers, grills, and vents, including anchors and sub frame materials where indicated or as required by new construction.
4. Modify existing openings for new construction as indicated on plans.
5. Provide new lintels as required by new construction.

H. Roofing

1. Remove roofing materials, flashing, skylights, mechanical units and other equipment as indicated on the drawings and in the project manual.

2. Provide temporary weather protection at all portions that are open to the weather.
 3. Coordinate roofing demolition with the new roofing specification.
- I. Mechanical, Electrical and Plumbing.
1. Refer to the mechanical, electrical, and plumbing drawings and specifications for equipment removal requirements.
 2. Provide cutting of holes in floors, partitions or ceilings for all mechanical, electrical, and plumbing as required.
 3. Remove all mechanical, electrical, and plumbing equipment and fixtures from partitions to be demolished.
 4. Remove all existing fixtures and equipment in areas scheduled to receive new fixtures and equipment unless instructed otherwise.
Patch and repair all substrate and finishes damaged by removal of items as required to match existing or to prepare for a new finish as scheduled. Dispose of all removed fixtures and equipment unless noted otherwise.

END OF SECTION

SECTION 026500
UNDERGROUND STORAGE TANK REMOVAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removal and disposal of underground storage tanks and connected piping.
- B. Cleaning and vapor freeing of tanks.
- C. Fuel removal.
- D. Temporary containment of excavated soil.
- E. Testing soils for contamination.
- F. Disposal of contaminated soil.
- G. Water disposal.
- H. Providing reports required by regulatory agencies.
- I. Backfilling.

1.02 RELATED REQUIREMENTS

- A. Section 017000 - Execution and Closeout Requirements: Dewatering of excavations and water control.
- B. Section 312323 - Fill: Fill materials, filling, and compacting.

1.03 PRICE AND PAYMENT PROCEDURES

- A. See Section 012200 - Unit Prices, for general requirements applicable to unit prices related to removal and disposal of underground storage tanks.
- B. Unit Prices: Assume for bidding purposes that concrete slabs, bituminous pavement, soil and water encountered during the removal of the underground tanks are contaminated with JP-5 fuel oil and shall be handled as specified herein.
 - 1. Payment for removal from temporary stockpile and disposal of contaminated soil and furnishing clean soil shall be paid for at the contract unit price per cubic yard (cubic meter).
 - 2. Bituminous pavement and concrete slabs shall be washed and disposed of as demolition debris. Wash water shall be collected and stored.
 - 3. Disposal of contaminated water shall be paid for at the contract unit price per liter (gallon).

1.04 REFERENCE STANDARDS

- A. API RP 1604 - Closure of Underground Petroleum Storage Tanks 2021.
- B. API PUBL 1628 - Guide to the Assessment and Remediation of Underground Petroleum Releases 1996.
- C. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications 2016.
- D. 29 CFR 1910 - Occupational Safety and Health Standards current edition.
- E. 29 CFR 1910.38 - Emergency action plans current edition.
- F. 40 CFR 280 - Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks current edition.
- G. COE EM-385-1-1 - Safety and Health Requirements Manual 2014.
- H. EPA SW-846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods Current Edition.
- I. EPA 600-4-790-20 - Methods for Chemical Analysis of Water and Wastes 1983.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Site Safety and Health Plan: Describe safety and health plan and procedures as related to underground tank removal and pipe removal, and as related to operations associated with petroleum contaminated soils and water.

- C. Excavation and Material Handling Plan: Describe methods, means, equipment, sequence of operations and schedule to be employed in excavation, transport, handling, and stockpiling of soil during underground tank removal.
 - 1. Submit to Architect fifteen days before beginning tank removal work.
 - 2. Include a material handling plan that describes phases of dealing with the contaminated soil and water as it relates to the proposed tank and piping removal.
 - 3. Include methods of excavating, a material handling plan for the contaminated material, soil testing requirements, safety precautions and requirements, and water pumping and collection requirements.
- D. Field Sampling and Laboratory Testing Plan: Describe field sampling methods and quality control procedures.
 - 1. Identify laboratory and laboratory methods to be used for contamination testing.
 - 2. Sample reports shall show sample identification for location, date, time, sample method, contamination level, name of individual sampler, identification of laboratory, and quality control procedures.
- E. Tank and Piping Removal and Disposal Plan: Describe methods, means, sequence of operations, and schedule to be employed in the testing, pumping, cleaning, de-vaporizing, inspecting, removal, and disposal of underground storage tanks and piping.
- F. Spill and Discharge Control Plan: Describe procedures and plan related to potential spills and discharge of contaminated soils and water.
- G. Reports:
 - 1. Identification of tanks removed and disposed of, including site map showing location of tank and piping.
 - 2. Starting and ending dates of reporting period.
 - 3. Closure report. Incorporate reports, records, and data into a single binder with the title "SITE ASSESSMENT REPORT" on the cover of the binder.
 - 4. Laboratory testing reports, including location of soil excavated and associated OVA/FID (organic vapor analyzer/flame ionization device) readings, and sampling and test results for:
 - a. TPH (total petroleum hydrocarbons).
 - b. BTEX (benzene, toluene, ethylbenzene, and xylene).
 - c. TCLP (toxicity characteristic leaching procedure); if BTEX indicates gasoline, then provide TCLP.
 - 5. Cumulative quantities of soil excavated, beginning with start date for each tank and associated piping.
- H. Record Documents:
 - 1. Building permit, inspection permits, and other permits required for underground tank removal.
 - 2. Results of excavation, including sketch showing location of underground storage tank, sampling locations, and extent of excavation.
 - 3. Tank disposal paperwork, such as copy of UST Notification Form and method of conditioning tank for disposal.
 - 4. Contaminated soil disposal paperwork, such as laboratory testing reports.
 - 5. Contaminated water disposal paperwork, such as laboratory testing results.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with local, state, and federal regulations and 40 CFR 280.
- B. Qualifications: Prior to start of work, submit documentation of recent experience and resumes of personnel working on the project.
 - 1. Data shall indicate that tank removal contractor, subcontractors, and personnel employed on the project have been engaged in removal, transportation, and disposal of underground tanks and associated piping, are familiar with and shall abide with the following:
 - a. API RP 1604.
 - b. 40 CFR 280 and State and local regulations and procedures.
- C. References: Furnish data proving experience on at least three prior projects that included types of activities similar to those in this project. Provide project titles, dates of projects, owners of projects, point of contact for each project, and phone numbers of each point of contact.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Plastic Sheetting: ASTM D4397.

PART 3 EXECUTION

3.01 PREPARATION FOR TANK REMOVAL AND DISPOSAL

- A. Site Safety And Health Plan (SSHP): Furnish safety, health, and accident prevention provisions and develop a Site Safety and Health Plan (SSHP).
 - 1. The SSHP shall incorporate the requirements of 29 CFR 1910 and COE EM-385-1-1.
- B. Spill And Discharge Control Plan: Develop, implement, and maintain a comprehensive spill and discharge control plan.
 - 1. The plan shall provide contingency measures for potential spills and discharges from handling and transportation of contaminated soils and water.
 - 2. A possible source of guidance for assessment and remediation is API PUBL 1628.
- C. Exclusion Zone (EZ) And Contamination Reduction Zone (CRZ): Do not permit personnel not directly involved with the project to enter work zones, called the EZ and CRZ.
 - 1. The EZ shall be an area around the tank a minimum of 10 feet (3 m) from the limits of the tank excavation.
 - 2. At the perimeter of the EZ, establish a CRZ.
 - 3. The Contractor's site office, parking area, and other support facilities shall be located outside the EZ and CRZ.
 - 4. Clearly mark and post the boundaries of the EZ and CRZ.
 - 5. Include a site map, outlining the extent of work zones and location of support facilities, in the SSHP.
- D. Personnel Protection: Furnish appropriate personal safety equipment and protective clothing to personnel.
 - 1. Ensure that safety equipment and protective clothing is kept clean and well maintained.
- E. Decontamination: Decontaminate or properly dispose of personal protective equipment and clothing worn in contaminated areas at the end of the work day.
- F. First Aid And Emergency Response Equipment And Procedures: Provide appropriate emergency first aid equipment for treatment of exposure to site physical and chemical hazards.
 - 1. Provide and post a list of emergency phone numbers and points of contact for fire, hospital, police, ambulance, and other necessary contacts.
 - 2. Provide and post a route map detailing the directions to the nearest medical facility.
- G. Ignition Sources: Do not permit ignition sources in the EZ and CRZ.
- H. Waste Disposal: The SSHP shall detail the practices and procedures to be utilized to dispose of wastes. Upon completion of the project, certify that equipment and materials were properly decontaminated prior to being removed from the site.
- I. Emergency Response Requirements: Furnish emergency response and contingency plan in accordance with 29 CFR 1910.38.
 - 1. In an emergency, take action to remove or minimize the cause of the emergency, alert the Architect, and institute necessary measures to prevent repetition of the emergency.
 - 2. Equip site-support vehicles with route maps providing directions to the medical treatment facility.
- J. Unforeseen Hazards: Notify the Architect of any unforeseen hazard or condition that becomes evident during work.

3.02 TANK CLEANING

- A. Fuel Removal:
 - 1. All possible fuel will be pumped or otherwise removed from the tank by Owner.
 - 2. Dispose of remaining fuel emulsions in accordance with applicable local, state, and federal regulations.

3.03 TEMPORARY CONTAINMENT OF EXCAVATED SOIL

- A. Provide temporary containment area near the excavated area.

3.04 EXCAVATION

- A. Provide Architect with written documentation, no later than 30 days before work begins, that proper state or local authorities have been notified.
- B. Notify Architect at least 48 hours prior to start of tank removal work.
 - 1. Stage operations to minimize the time that tank excavation is open and the time that contaminated soil is exposed to the weather.
 - 2. Provide protection measures around the excavation area to prevent water runoff and to contain the soil within the excavation area.
- C. Excavation: Excavate as required to remove tanks and piping.
 - 1. Place soil removed from the excavation in a temporary containment area.
 - 2. Collect and temporarily store water runoff from stockpiled soils.
- D. Excavation Methods: Select methods and equipment to remove soil to minimize disturbance to areas beyond the limits of the excavation area.
 - 1. Material that becomes contaminated as a result of Contractor's operations shall be removed and disposed of at no additional cost to Owner.
 - 2. Where excavation extends into groundwater levels, dewatering methods shall be employed on a localized basis to facilitate excavation operations, as specified in Section 017000.

3.05 TESTING

- A. Stockpiled Soils: Soils with OVA/FID readings of 10 ppm or greater shall be further sampled and tested.
 - 1. Test for TPH and for BTEX in accordance with EPA SW-846 and EPA 600-4-790-20.
 - 2. Test for toxicity characteristic leaching procedure (TCLP) for lead if leaded gasoline was stored in or near the underground tank being removed.
 - 3. For TPH, provide a minimum of one test for every 100 cubic yards (77 cubic meters).
 - 4. For BTEX and TCLP, provide one test for every 100 cubic yards (77 cubic meters).
 - 5. Soils that contain 50 ppm or more TPH, 10 ppm or more BTEX or have TCLP reading of 10 ppm lead or virgin petroleum products are considered contaminated materials.
 - 6. Soils that test at levels less than the above may be used as clean fill.
 - 7. Furnish results to Architect within 24 hours after the results are obtained.
- B. Testing Under Tank After Removal of Tank:
 - 1. If tank is 20 feet (6 m) or less in length, take two samples. Each sample shall be 2 feet (0.60m) from each end of the tank and 2 feet (0.60 m) below the bottom of the excavation.
 - 2. If the tank is greater than 20 feet (6 m), take three samples. Two samples shall be 2 feet (0.60 m) from each end of the tank and 2 feet (0.60 m) below the bottom of the excavation. A third sample shall be taken from the middle of the tank area and 2 feet (0.60 m) below the bottom of the excavation.
 - 3. Analyze samples for TPH, BTEX, and TCLP.
 - 4. Comply with standards for sampling and analysis as specified above for stockpiled soils.
 - 5. Test for TPH and for BTEX in accordance with EPA SW-846 and EPA 600-4-790-20.
 - 6. Soils that contain 50 ppm or more TPH, 10 ppm or more BTEX, or have TCLP reading of 10 ppm of lead or virgin petroleum products are considered contaminated materials.
 - 7. Soils that test at levels less than the above may be used as clean fill.
 - 8. Furnish results to Architect within 24 hours after the results are obtained.
- C. Testing Along Piping:
 - 1. For every 25 linear feet (7.5 m) of product delivery piping, for every change in direction, and at every mechanical joint take one soil sample and analyze for TPH, BTEX, and TCLP.
 - 2. Comply with requirements for sampling and analysis of soil materials as specified above in the paragraph entitled "Testing Under Tank After Removal of Tank."

3.06 WATER DISPOSAL

- A. Dewatering will be permitted only with approval of Architect.
- B. Store and test water generated during removal of tanks and piping.
 - 1. If contaminated, transport and dispose of water in an EPA approved disposal site in accordance with federal, state, and local requirements.

2. Non-contaminated water may be disposed of on-site.

3.07 DISPOSAL OF UNDERGROUND TANKS, ANCHORS , SLABS, AND ASSOCIATED PIPING

- A. Preparation: API RP 1604. Remove the fill pipe, gauge pipe, vapor recovery truck connection, submersible pumps, and drop tube.
 1. Cap or remove non-product piping, except vent piping.
 2. Plug tank openings so that vapors will exit through vent piping during the vapor-freeing process.
- B. Purging: Remove flammable vapors in accordance with API RP 1604. Tanks shall be certified as "vapor free" prior to further work.
- C. Cleaning and Testing: Clean tank and perform atmosphere testing in accordance with API RP 1604.
 1. Distribution (product delivery) piping shall be cleaned and removed or the piping shall be cleaned, filled with concrete, and abandoned in place.
 2. Test the tank atmosphere and the excavation area for flammable or combustible vapor concentrations, with a combustible gas indicator until the tank is removed from the excavation and from the site.
- D. Tank Removal and Disposal:
 1. Plug or cap accessible holes. One plug shall have a minimum 1/8 inch (3 mm) vent hole.
 2. Remove tank from the excavation, place it on a level surface and render it useless in accordance with API RP 1604.
 3. Provide warning labels on tank if tank contained leaded fuels, as follows:
 - a. "TANK HAS CONTAINED LEADED GASOLINE -- NOT VAPOR FREE -- NOT SUITABLE FOR STORAGE OF FOOD OR LIQUIDS INTENDED FOR HUMAN OR ANIMAL CONSUMPTION -- DATE OF REMOVAL: MONTH/DAY/YEAR"
 4. Transport and dispose of tank at an EPA approved disposal site in accordance with federal, state, and local regulations.

3.08 INSPECTIONS

- A. Arrange for and perform required inspections. Provide copies of inspections to the Architect.

3.09 CLOSURE REPORT (SITE ASSESSMENT REPORT)

- A. Provide Architect a Site Assessment Report in a single binder notebook that contains the full collection of reports relating to this work, including but not limited to, records, starting and ending dates of reporting period, inspections, documentation, and data as follows:
 1. Complete UST Notification Form (within 30 days of closure).
 2. Description of work, including removal procedures, number of tanks removed, identification of tanks removed and disposed of, cubic yards of excavated soil, location of disposal sites, and dates of excavation.
 3. Site plan, including location of tanks and piping, limits of excavation, sampling points, results of excavation, and depths.
 4. Laboratory testing reports, copies of data and test results from testing laboratory.
 5. Tank disposal paperwork, contaminated soil disposal paperwork, and contaminated water disposal paperwork.
 6. Certifications required by implementing agency.
 7. Building permit, inspection permits, and other permits required for underground tank removal, notifications, and inspection reports.
 8. Cumulative quantities of soil excavated, beginning with start date for each tank and associated piping.

3.10 SPILLS OF CONTAMINATED SOILS

- A. Use appropriate vehicles and operating practices to prevent spillage or leakage of contaminated materials from occurring during operations. Inspect vehicles leaving the area of contamination to ensure that no contaminated materials adhere to the wheels or undercarriage.

3.11 BACKFILLING

- A. Provide backfill, compaction, grading, and seeding in accordance with 312323.
- B. Line the excavation with two plastic sheets before backfilling.

END OF SECTION

SECTION 02 83 13

LEAD PAINT CONSIDERATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The Drawings and general provisions of the Contract, including General Conditions, and Division 1 Requirements, apply to the work in this Section.
- B. Section 09 91 00 - Painting

1.02 DESCRIPTION OF WORK

- A. The work of this Section specifies minimum requirements for the disturbance, removal, containment, and disposal of lead-containing paint, building components coated with lead-containing paint, and associated waste generated as a result of paint removal activities as indicated in the Contract Documents.
All existing paint is to be assumed to contain lead.
- B. The procedures described herein shall apply to all paint removal work where a worker may be occupationally exposed to lead, as well as the disposal requirements of the paint.
- C. The Contractor shall assume that any painted surface, for which representative test results are not otherwise available, to be coated with lead-containing paint. It shall be the Contractor's responsibility to protect workers performing under this Contract.
- D. The Contractor shall assume full responsibility and liability for the compliance with all applicable Federal, State and local regulations pertaining to work practices, disposal of hazardous waste, protection of workers and visitors to the site. The Contractor shall hold the Owner's Representative and Architect harmless for failure to comply with any applicable work, disposal, safety, health or regulation on the part of themselves, their workers or their subcontractors.
- E. The Contractor is required to ensure the protection of workers performing any work that will affect surfaces coated with lead paint as well as protecting the public and the environment from exposure to lead dust.
- F. The General Contractor is hereby duly made aware of the presence of lead paint to satisfy the hazard communication requirements set forth by OSHA regulations. Specifically, contractors and subcontractors are required to comply with OSHA regulations including 29 CFR 1926.62, *Lead Exposure in Construction: Interim Final Rule* and 29 CFR 1926.59, *Hazard Communication for the Construction Industry*.

1.03 CODES AND STANDARDS

- A. All work shall conform to the standards set by applicable Federal, State and local codes, laws, regulations, ordinances, and guidelines in such form in which they exist at the time of the work on the contract and as may be required by subsequent regulations.

- B. In addition to any detailed requirements of the Specification, the Contractor shall at their own cost and expense comply with all laws, ordinances, rules and regulations of Federal, State, and Local Authorities regarding removal and disposal of lead waste material.
- C. The following regulations and guidelines are cited for the information and guidance of the Contractor. The list below is not all-inclusive; the Contractor shall be responsible for a thorough knowledge and full implementation of all requirements for the removal, transport and disposal of lead-containing materials.
 - 1. U.S. Environmental Protection Agency 40 CFR Parts 260 – 272.
 - 2. Federal Occupational Safety and Health Administration (OSHA) Title 29 CFR 1910 and 29 CFR 1926, including but not limited to:
 - (a) 29 CFR 1926.62 – Lead in Construction
 - (b) 29 CFR 1910.134 – Respiratory Protection
 - 3. American National Standards Institute (ANSI) Publications:
 - (a) Fundamentals Governing the Design and Operation of Local Exhaust Systems
 - (b) Practices for Respiratory Protection
 - 5. National Institute of Occupational Safety and Health (NIOSH) Publications:
 - (a) Manual of Analytical Methods, 4th Ed.
 - 6. Underwriters Laboratories, Inc. (UL) Fire Resistance Directory Publications:
 - (a) 586-77 (R 1982) Test Performance of High Efficiency Particulate, Air Filter Units.
- D. All regulations by the above and other governing agencies in their most current version are applicable throughout this project. It is the Contractor's responsibility to know, understand, and abide by all such regulations and practices. Where there is a conflict between this Specification and the cited State, Federal, or local regulations, the more restrictive or stringent requirements shall prevail.

1.04 SUBMITTALS

- A. Contractor's Lead Compliance Program as required by OSHA.
- B. Site specific work plan identifying specific work areas, procedures, methods, and proposed schedule to be used on project.
- C. Copies of all notifications, permits, applications, licenses and like documents required by Federal, State, or local regulations.
- D. Post-Construction submittal package:
 - 1. Copies of waste manifests and receipts acknowledging disposal of all lead waste material from the project, showing delivery date, quantity, and appropriate signature of landfill's authorized representative,

1.05 SPECIAL CONSIDERATIONS

- A. Workers shall be informed of the components to be impacted during renovation that have been

identified as containing lead.

- B. Separation of Trades: Unprotected, untrained workers or trades shall not perform any related work within the same vicinity as work involving components identified with lead.

1.06 REPORT OF FINDINGS

- A. The Contractor shall assume that all paints impacted by the work contain lead.

1.07 FEES, PERMITS & LICENSES

- A. Contractor shall be responsible for costs for all licensing requirements, where applicable and notification requirements, and all other fees related to the Contractor's ability to perform the work in this Section
- B. Secure all necessary permits required to perform the specified work.

1.08 CLEAN UP

- A. Maintain the work site in a neat and orderly manner at all times, so as not to interrupt or infringe upon the work of other trades.

1.09 COORDINATION

- A. At no time shall the Contractor cause or allow to be caused conditions that may cause risk or hazard to the general public or conditions that might impair safe use of the facility.

1.10 DISPOSAL OF WASTE MATERIAL

- A. The Contractor shall comply with all applicable state and local regulations.
- B. Contractor shall comply with all EPA regulations.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 SCHEDULING

- A. The Contractor shall coordinate all scheduling with the Owner's Representative.

3.02 IDENTIFICATION OF HAZARDS

- A. The Contractor shall identify all work activities in which a worker may be occupationally exposed to lead.
- B. The Contractor shall initially determine if any worker may be exposed to lead above the action level.

3.03 BARRIERS AND ISOLATION AREAS

- A. Work area isolation for paint removal using hand scraping or abrasive methods or for removal of painted components shall at a minimum be sealed off using plastic sheeting and taped perimeters. Verify actual conditions at site with Architect. Appropriate signage shall be posted around the work area.

3.04 PAINT REMOVAL

- A. All paint chips, slurry, waste, and debris generated from paint removal shall be removed immediately upon generation during the work.

3.05 PERSONAL SAMPLING - CONTRACTOR

- A. Perform personnel air sampling during all renovation work to determine worker exposure limits. The results of such sampling shall be submitted to the Architect.
- B. Air monitoring frequency will be established in accordance with the requirements set forth by OSHA.

3.06 WORK PROCEDURES

- A. The contractor shall initiate, and continue, sufficient engineering and work practice controls, as described in the Contractor's Lead Compliance Program, to reduce and maintain worker exposures to lead at or below the Action Level
- B. The following work practices are specifically required by these specifications:
 - 1. All persons except those directly involved in the work shall be excluded from the work area.
 - 2. Provide hand-washing facilities and ensure that all workers thoroughly wash their hands and face upon exiting the work area.

3.07 STORAGE OF WASTE

- A. Use of waste containers on site shall be controlled under the following requirements:
 - 1. Wastes shall be handled, packaged, transported and disposed of in accordance with applicable federal and state regulations, codes and laws.
 - 2. Location of waste containers on site shall be coordinated with the Architect.
 - 3. Waste containers shall be lined with two layers of six-mil polyethylene sheeting, be solid, enclosed containers, locked and sealed at all times.

END OF SECTION

SECTION – 03 31 10

CONCRETE CONSTRUCTION

PART 1 - GENERAL

- 1.01 SCOPE: Include labor, materials, equipment, appliances and work required for the complete execution of standard Concrete Construction, reinforced and plain, indicated on the drawings or herein specified.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Cement: Cement shall be Portland cement Type 1, conforming to ASTM Specification C-150.
- B. Fine Aggregate: Sand for concrete work shall conform to ASTM Specification C-33.
- C. Coarse Aggregate: Coarse aggregate shall be gravel or crushed stone conforming to ASTM Specification C-33.
- D. Water: Water used in mixing concrete shall be clean and free from injurious or deleterious substances.
- E. Metal Reinforcement: Reinforcing bars in general shall conform to the requirements of the "Standard Reinforcement" (ASTM Designation: A-15), and shall be intermediate grade.
- F. Wire Fabric: Welded wire fabric for concrete reinforcement shall conform to requirements of "Standard Specifications for Welded Steel wire Fabric for Concrete Reinforcement" (ASTM Designation A-185).
- G. Metal Accessories and Inserts: Include necessary devices for proper placement of concrete and install sleeves, inserts, bolts as required.
- H. Expansion Joints: Provide 1/2" expansion joint at junction of concrete slab and existing concrete work.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Concrete details shall conform to the current provisions of the A.C.I. Code. Design and strength of concrete shall develop 3000 lbs. per sq. inch at 28 days.
- B. Concrete Mixing: The Contractor shall use ready-mixed concrete. Ready-mixed concrete shall be mixed and delivered in accordance with requirements set forth in "Standard Specifications for Ready-Mixed Concrete" (ASTM Designation C-94).
- C. Metal Reinforcement: Concrete slabs shall be reinforced with 6x6 No. 10 Steel Mesh and/or reinforcing bars of sizes indicated on plans.

D. Placing of Concrete:

1. Concrete slabs shall be placed on well compacted gravel base. Gravel base shall be 8" deep.
2. The placing or depositing of concrete shall be done in accordance with requirements of the A.C.I. Building Code 318-63.

E. Construction Joints: Shall be located only as herein specified, where shown on the drawings or as approved by the Architect. Maximum 20'-0" in all directions.

F. Curing and Protection: Protect all concrete work against injury from elements and defacement of any nature during construction operations.

3.02 CEMENT FINISHED:

- A. Monolithic Finish: Floor slabs shall be finished by tamping the concrete with special tools to force the coarse aggregate away from the surface then screeding and floating with straight edges to bring the surface to the required finish level. While the concrete is still green but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood-floated to a true, even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood float to bring moisture to the surface. After surface moisture has disappeared, surfaces shall be steel-troweled to a smooth, even, impervious finish free from trowel marks.
- B. Wood Float Finish: Shall be provided for exterior concrete slabs, ramps, stairs and platforms. The surfaces shall be finished by tamping the concrete to force coarse aggregate away from surface, screeding and floating to bring the surfaces to the required finish level and wood-floated to an even, smooth surface.

3.03 CONCRETE EQUIPMENT PADS:

- A. Concrete equipment pads are to be constructed in the locations, to the sizes and details indicated on the drawings.
- B. Pads are to be 1'-4" thick of 4000 psi concrete on a 12 inch thick compacted gravel base course. (Unless thicknesses are noted otherwise on the drawings)
- C. Provide reinforcing as shown on drawings with a 3 inch minimum cover.
- D. Surface to have a 1:50 pitch for drainage. The surface shall drain so that no water stands on the surface.
- E. Concrete shall be struck off with a wood screed and then floated with a wood float and broom to produce an even, gritty surface.
- F. All exposed corners of slabs shall be edged with a 3/4" chamfer.
- G. Concrete pads shall be cured by covering with wetted burlap kept damp for 7 days or other approved method.

END OF SECTION

SECTION 05 50 00

MISCELLANEOUS METAL WORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Related Documents:
The Drawings and general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 Requirements, apply to the work in this Section.

1.02 SECTION INCLUDES

- A. Miscellaneous metal work items as described in this Specification Section.
- B. Section includes, without limitation, providing and installing:
 - 1. Shop applied ferrous metals priming paint for miscellaneous metals.
 - 2. Anchorages, brackets, supports, inserts and backing required for a complete job but not included in other sections.
 - 3. All other ferrous or non-ferrous metal work not specifically given to other Sections and necessary for a complete job, but including:
 - c. Galvanized steel framing and supports for mechanical and electrical equipment.
- C. Items To Be Furnished Only: Furnish the following items for installation by others.
 - 1. Masonry:
Miscellaneous metal and iron sleeves, anchors, inserts, plates and lintels to be built into masonry walls, including:
 - a. Furnishing loose bearing plates with headed anchors to support steel beams and metal deck on masonry.
 - b. Loose steel bearing and leveling plates, including bearing plates for steel joists, beams and purlins, galvanized at exterior locations and in exterior walls.
 - c. Epoxy anchors to fasten seismic clips to masonry.
 - d. Anchor bolts to fasten spandrel beams to masonry.
 - e. Galvanized steel lintels at exterior locations.
 - f. Steel lintels with shop applied zinc-rich primer at interior locations.
 - 2. Miscellaneous items
 - a. Miscellaneous steel trim, galvanized at exterior locations.
 - b. All plates, threaded rods and angles required to support suspended HVAC units from building structure.

1.03 RELATED SECTIONS

- A. Section 09 90 10 – Painting

1.03 SUBMITTALS

- A. Submit shop drawings, product data under provisions of Section 01 33 00. Include plans, elevations, sections, details, and attachments to other work. Show anchorage and accessory items.
- B. Submit samples of product as requested by the architect. Submit 8" square samples of each metal shop or factory finish (final surface treatment) required. Prepare samples on metal of same alloy and gauge to be used for the work. Label each sample to identify substrate material and finish. Provide hardware samples.
- C. Manufacturer's Data: Submit manufacturer's specifications, anchor details and installation instructions for any prefabricated products to be used in the work of this section

1.04 REGULATORY REQUIREMENTS

- A. Conform to all federal, state, and local codes.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Engineering Calculations: Calculations stamped by a registered professional engineer are required for load bearing fabrications. The Structural Engineer's written approval of such calculations shall be obtained before commencing fabrication

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.

1.07 FIELD MEASUREMENTS

- A. Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 GENERAL FABRICATION REQUIREMENTS

- A. Welding shall conform to the applicable requirements of the American Welding Society. Welding shall be done in a manner that will prevent permanent buckling and all welds exposed in the finished work shall be ground to an architectural quality smooth appearance approved by the Architect.
- B. Exposed surfaces shall have a smooth finish and sharp, well defined lines. Sections shall be formed to shape and size with sharp lines and angles. Curved work shall be sprung evenly.

- C. Necessary rabbets, lugs and brackets shall be provided so that work can be assembled and anchored in a neat and substantial manner. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable.
- D. Work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, insure rigidity and provide close fitting of sections. Joints exposed to the weather shall be formed to exclude water.
- E. All galvanized metal shall bear a stamp indicating ASTM number and weight of zinc coating in ounces per square foot.

2.02 MATERIALS

- A. Materials shall conform to the latest edition of the specifications or manufacturer's standards.
 - 1. Steel Shapes ASTM A-36 Bars & Plates
 - 2. Anchor Bolts ASTM A-307 Grade A
 - 3. Structural Bolts ASTM A-325 (unless shown or indicated otherwise)
 - 4. Weld Material E70XX Welding Electrodes For manual shielded metal-arc welding, AWS A5.1 or A5.5, E60 or E70 series
 - 5. Galvanizing ASTM A-123, , or A-153 as applicable; 2.0 ounces zinc per square foot, unless otherwise indicated; provide under its section.
 - 6. Stainless Steel Type 304L, ASTM A 276
 - 7. Bitumastic Preservative Mil-P-15230 [Where shown and all embedded steel]
 - 8. Galvanized Sheet Steel ASTM A-526 or A-526, G-90
 - 9. Hot-Rolled Carbon Steel Bars (and Bar-Size Shapes): ASTM A-36 or A-529, grade as selected by fabricator.
 - 10. Brackets, flanges and exposed fastenings: Shall be of the same materials, color and finish as the metal to which they are applied, unless shown or specified otherwise.
 - 11. Expansion bolts at concrete: Red Head (or equal) wedge anchors.
 - 12. Expansion bolts at CMU: Hilti (or equal) epoxy/masonry anchors
- B. Hangers and suspension: Where required, provide Uni-strut (or equal) A1000 or assemblies of types recommended by manufacturer for application.
- C. Galvanizing Repair Paint: High zinc dust content paint, ZRC (or equal), having 95% zinc. by weight. Two coats always are required.

2.03 SHOP PAINTING

- A. All surfaces of ferrous metal except galvanized steel shall be given a shop coat of red lead, zinc-chromate paint or other approved rust-inhibitive primer unless otherwise specified. All surfaces which will be inaccessible for painting after erection, except contact surfaces of riveted or welded connections, shall be given two coats of paint before being assembled or erected. All marred surfaces of shop coats shall be thoroughly recoated. Field painting is specified under Section 09 91 00.

2.04 ANCHORING CEMENT:

- A. Anchoring non-shrink grout shall be Hallemite "Por-rok" or equal.

2.05 CLEANING:

- A. Clean under provisions of Section 01 70 00.
- B. The Contractor shall clean the miscellaneous metal work by removing all excess sealants, dirt and foreign materials, restoring finishes, leaving work in a good and satisfactory condition. The Contractor shall perform the work of cleaning using methods and materials as recommended by the manufacturers of the materials used and as approved.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Review existing field conditions of areas to receive the work of this Section before proceeding with fabrication. Do not proceed with installation of metal fabrications until all unsatisfactory conditions which would impair the strength or appearance of the work have been corrected.

3.02 INSTALLATION OF METAL FABRICATIONS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners and furnish all necessary setting drawings, diagrams, and templates where necessary for securing miscellaneous metal items to in-place construction including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Use galvanized bolts at exterior. Coordinate delivery of such items to project site.
- B. Cutting: Perform cutting, drilling and fitting required for installation of miscellaneous metal items. Do not cut structural members in field to facilitate fitting without written permission of the Architect for each specific condition.
- C. Fitting: Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- D. Placement: Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work. Do not field weld stainless steel or aluminum.
- F. Grouting: Set bearing plates required for support of the work of this Section level and to correct elevation using steel shims or wedges and grout solid using specified non-shrink grout.

- G. Touch-Up of Shop Primers: Touch up field welds and unprimed steel using specified shop primers and following procedures specified for shop work.
- H. Existing work: Remove and re-install or re-locate existing metal fabrications as required to complete the work. Drill, tap, or weld existing assemblies as required to complete the work and to attach existing work to new work.

3.03 PRODUCTS

- A. Anchors and Bolts:
Anchors and bolts shall be provided where indicated and where necessary for fastening work in place. They shall be embedded in concrete and masonry as the work progresses. Sizes, kinds and spacing of anchors not indicated or specified shall be as necessary for their purpose.
- B. Steel:
Steel for the support of piping and appurtenances shall be provided to the details indicated and as necessary for the complete installation.
- C. Pipe Hangers and Miscellaneous Supports:
Pipe hangers and miscellaneous supports shall be provided as required.
- D. Miscellaneous Framing and Supports:
 - 1. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required.
 - 2. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive work to be supported by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
 - 3. Equip units with integrally welded anchor straps for casting into poured concrete or building into masonry wherever required. Furnish concrete inserts if units must be installed after concrete is placed.
- E. Metal support framing:
 - 1. Provide metal framing as required to support piping, HVAC equipment and ductwork below hard or acoustical ceilings or as required to span across/over/under suspended equipment. Coordinate with the associated MEP contract documents.

3.04 REPAIR OF ZINC COATINGS:

- A. All zinc coatings that have been damaged in handling or transporting or in welding, riveting or bolting shall be repaired by the application of a thick paste made from galvanizing repair compound conforming to Federal Specification 0-G-93 and water. Areas to be repaired shall be cleaned thoroughly, including removal of slag on welds, before the paste is applied. Surfaces to be coated with paste shall be heated with a torch so that all metallics in the paste will be melted when applied to the heated surfaces. Extreme care shall be taken to see that adjacent zinc-coated surfaces are not damaged by torch. Molten metal shall spread uniformly over all surfaces to be coated and the excess metal wiped off.

3.05 FIELD PAINTING

- A. Specified as scheduled under Section 09 91 00 - Painting.

3.06 DISSIMILAR MATERIAL

- A. Where aluminum comes in contact with metals other than stainless steel, zinc, white bronze or other metals compatible with aluminum, then those surfaces shall be kept from direct contact by painting the dissimilar metal with a coating of heavy-bodied bituminous paint, a good quality caulking placed between the metals, non-absorptive tape or gasket.

END OF SECTION

SECTION 06 20 10

CARPENTRY AND MILLWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Related Documents:
The Drawings and general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 Requirements, apply to the work in this Section.

1.02 SECTION INCLUDES

- A. All labor and materials, equipment and installation of all work required to complete the construction and installation of all work required to this trade as indicated on the drawings and as herein specified.

1.03 RELATED SECTIONS

- A. Section 09 91 00 – Painting

1.04 REFERENCES

- A. American Plywood Association
- B. American Woodwork Institute

1.05 SUBMITTALS

- A. Submit shop drawings, product data and samples under provisions of Section 01 33 00.

1.06 QUALITY ASSURANCE

- A. Work shall comply with all local and state building and fire codes.
- B. Material and workmanship of all woodwork shall conform to the Premium grade requirements of the AWI Quality Standards.
- C. Rough Carpentry Lumber: Visible grade stamp, of agency certified by National Forest Products Association (NFPA).

1.07 REGULATORY REQUIREMENTS

- A. All materials are to conform to the minimum requirements of the State Building Code or as indicated in this specification, whichever is stronger or stricter.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Protect all materials from weather. Do not store in damp or wet areas. Stack lumber and plywood, and provide air circulation within stacks.

1.09 FIELD MEASUREMENTS

- A. Verify all field dimensions at the site prior to fabrication.

1.10 COORDINATION

- A. Coordinate work with other trades and under provisions of Section 01 31 00.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Framing Lumber
 - 1. Moisture content when delivered to the project shall not exceed 19 percent.
 - 2. Wood studs, blocking, bridging, nailing pieces, shall be Douglas Fir, Coast Region construction grade "J" and "P" or Southern Pine No. 1. All structural load bearing lumber shall be of quality to provide 1200 psi units fiber stress.
 - 3. Mark of treating company certifying type of treatment applied on fire retardant treated and pressure preservative treated lumber.
- B. Plywood shall be of the types and grades listed below:
 - 1. Exposed interior plywood to be American Plywood Association A-C, Group 1, Exposure 1, in thickness as noted on the drawings. Where thickness is not indicated, plywood shall be 3/4" thick.
 - 2. Each panel of plywood shall be identified with a stamp as to type, grade and species by the grade trademark of the American Plywood Association.
Mark of treating company certifying type of treatment applied on fire retardant treated and pressure preservative treated plywood.
 - 3. All sheathing plywood shall be in accordance with Chapter 23 of the State of Rhode Island Building Code.
- C. Interior and Exterior Woodwork for Paint Finish
 - 1. Quality: Wood shall be free from knots, pitch or sap streaks, molded and executed as detailed and noted on the drawings.
 - 2. Species: Wood shall be clear, kiln-dried close-grained hardwood unless otherwise indicated.
- D. Wood Treatment
 - 1. Wood preservative used to treat the wood materials shall be alkaline copper quaternary (ACQ).
 - 2. Treat wood materials requiring pressure impregnated preservatives to FS TT-W-571, Table 3.

3. Deliver treated materials cut to required sizes. Minimize field cutting.
4. Re-dry wood after pressure treatment to maximum 19 percent moisture content.
5. Use stainless steel fasteners where installed in pressure treated wood.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Rough Carpentry

1. General: Carefully lay out, cut, fit and rout all framing, blocking and other items of carpentry in such a manner as to minimize shrinkage and insure stability. Perform all carpentry work required for building in work of other trades and work to the details indicated and as required by field conditions.
2. Provide fire retardant treated wood products as shown and as follows:
At exposed or semi-exposed wood in fire rated assemblies and in spaces having limited flame spreads for exposed combustibles. Where blocking is concealed in fire rated assemblies and all areas as required by code.
3. Includes: Rough carpentry shall consist of the installation of sleepers, blocking, nailers, curb nailers, furring, joists, studding, rafters, stringers, centers, rough flooring, grounds, screeds, and such other items of rough carpentry as may be required for proper construction and to complete the work. Absence of illustration, detail or specification will not relieve the Contractor from responsibility or carrying out the work.
4. Lumber and other rough work shall be properly framed closely fitted, accurately set to the required lines and levels and rigidly secured in place.
Joists and rough stair stringers shall be set with the crown edge up, and the bottom edges shall be free from pronounced defects.
Leveling of sills, etc., on masonry or concrete shall be done, as required and grouted with cement mortar.
Studs and joists shall be sized to give true surfaces for finish.
Nailing and spiking shall be done in a thorough manner with nails of ample size, spikes larger than 20d being used where practicable.
Special framing or construction, not explicitly shown on drawings or specified, shall be provided as required to complete the work in the best and most workmanlike manner.
5. Mechanical equipment clearances: Members shall be framed to allow for passage of pipes or ducts as required to avoid cutting of structural members. No members shall be cut, notched or bored for the passage of such pipes without permission of the Architect, and all members damaged by cutting shall be reinforced as directed by the Architect.
6. Preservative treated lumber: All wood in direct contact with concrete, masonry, soil or gravel shall be preservative treated wood, ground contact grade with a 40 year warranty. Wood shall be free from large or loose knots, shakes, checks and warp. Apply two coats of same preservative used in original treatment to all sawn or cut surfaces of treated lumber, in accordance with AWP A M4.
Use stainless steel fasteners where installed in the pressure treated wood.
7. Studs: Studs shall be no less than 2"x4", spaced not over 16 inches on center, unless otherwise shown. Studs shall be doubled around all openings. Corners shall be thoroughly spiked together and made solid. All bearing partitions shall be provided with double top and bottom plates. Partitions shall have one row of horizontal bridging for the full width of studding, cut in and securely nailed. Studs shall be framed as shown or required for the proper installation of trim, plumbing, and other work to be concealed. Studding shall be installed for the support of all fixtures and accessories as required.

8. Furring and Grounds: Shall be minimum 1" x 3" strips, as shown on drawings or as required to match the condition, spaced maximum 16" on center and continuous at all vertical edges of framed openings. Furring shall be secured to concrete, brick or masonry units by power driven fasteners. Face of furring and grounds shall form a true, even plane for installation of materials thereon. Species shall be Fir or Southern Pine, at Contractor's option.
 9. Joists: Except where otherwise shown, all joists shall have bearings of not less than 4 inches. Where possible, joists shall be lapped and spiked together at bearings and spiked to studs where the same occurs. Openings shall be framed with headers and trimmers. Headers carrying more than one tail-joist shall be tripled. Metal double cross bridging shall be provided at the center of span of all floor and ceiling joists and as indicated.
 10. Trim
 - a. Trim shall be mitered and jointing shall be tight and formed to conceal shrinkage. All mortise, tongue-and-groove and shiplap joints shall be set in neutral white caulking compound. Interior woodwork shall be back primed and painted before installation.
 - b. Interior trim shall be milled, fabricated and erected as shown on the drawings. All finishes shall be machine-sanded at the mill and sand-papered and primed at the job.

Wood used for trim is to be any close-grained hardwood.

All interior trim including base, chair rails, ceiling mouldings, casings, window stools and aprons shall be of stock designs. All joints shall be made in an approved manner to conceal shrinkage and shall be tight, straight, plumb and level, in perfect alignment and closely fitted. Joints shall be secured with finish nails set for putty stopping. Window and door trim shall be in single lengths. Base shall be in long lengths. Mouldings shall be mitered at corners and coped at angles. These joints shall be made at the mill.
 11. Temporary Enclosures and Protection: Temporary enclosures of doors, windows and other exterior openings shall be provided when necessary to meet conditions specified. Maintain in good repair and remove when no longer required. Door and window frames shall be protected from traffic and from mortar drippings.
- B. Blocking
1. Blocking layout and size: Continuous and solid, fire retardant 3/4 inch plywood or fire retardant 2x4 or larger where additional support is required.
 2. Provide blocking in addition to any indications on the drawings in locations as follows:
 - a. All standing and running trim
 - b. Equipment attached to walls or ceilings.
 - c. Fin-tube radiation heating.
 - d. At exterior items or fixtures mounted or attached where insulating sheathing, or cement, vinyl, PVC, or wood-lapped board siding or trim is used.
 3. Attach blocking as follows:
 - a. In metal stud partitions: Screw attach through stud flanges.
 - b. At masonry: With oval head toggle bolts and washers or with epoxy tube and sleeve systems.
 - c. At concrete: With expansion shield bolts.
 - d. At steel: With flat head bolts/nuts or approved power actuated fasteners.
- D. Plywood backer panels:

1. Material: APA C-D Plugged Exposure 1 with exterior glue
2. Fire retardant.
3. Coatings: Fire retardant paint, six sides, applied before installation.
4. Coating color: As shown or directed, if not, black.
5. Thickness: As indicated, if not, 3/4 inch.
6. Provide and install fire retardant plywood backer panels for surface mounted electric panel boards, meter mounts, protection cabinets, motor control panels and the like. Boards shall be rigidly built and securely fastened to wood-furred strapping at walls in approved manner.

E. Construction Hardware

1. Furnish and install all bolts, nuts, expansion shields, lag screws, toggle bolts, wood screws, nails, flat cap metal nailing discs, staples, power driven anchors and other rough hardware as required.
2. Rough hardware items shall be of appropriate type and proper capacity and size as required for each specific application.
3. All fasteners used on exterior work shall be hot dip galvanized or stainless steel.
4. Concrete and masonry anchors: Where anchors are not included in concrete or masonry construction sections, anchors shall be galvanized machine screws or bolts with standard expansion-shield type concrete anchors, Phillips "Red Head" Masonry Anchors or approved equal, of sizes and types as required.
5. Fasteners used at treated wood: Fasteners meeting manufacturers approval and requirements if not listed use stainless steel.

3.02 CLEANING

- A. Clean work under provisions of 01 70 00.

3.03 PROTECTION OF FINISHED WORK

- A. Protect finished work under provisions of Section 01 70 00.

END OF SECTION

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SECTION 07 50 01

REPAIRS TO EXISTING ROOF

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Repairs to existing roof where modified for installation of new construction elements.

1.02 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Include manufacturer's specifications of materials and installation instructions.
- C. Samples: Submit if requested by the Architect.

1.03 QUALIFICATIONS

- A. Installer: Company specializing in installing the roofing system products required in this section with minimum of three years documented experience.

1.04 REGULATORY REQUIREMENTS

- A. Conform to all applicable Federal, State and local codes and laws.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.

1.06 FIELD MEASUREMENTS

- A. Verify actual dimensions with field measurements before fabrication.

1.07 EXISTING WARRANTY

- A. Existing EPDM roofing system is not under warranty.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Furnish materials compatible with existing roofing materials. Match or exceed quality, weights, type and finishes of existing materials. Provide, as applicable, but not limited to:
 - 1 Vapor retarders.
 - 2 Adhesives.
 - 3 Insulation materials & recovery board.
 - 4 EPDM Membrane.
 - 5 Surface coatings.
 - 6 Base flashings.
 - 7 Metal flashings.
 - 8 Expansion joint materials.
 - 9 Crickets and Cant strips.
 - 10 Pipe seals.
 - 11. Mechanical equipment curb.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All modifications to the existing EPDM roofing system are to be made in accordance with the manufacturer's instructions.
- B. Protect existing elements surrounding the work of this section from damage or disfigurement.
- C. Repair damages, if occurring, caused by foot traffic and movement of tools, equipment, and products across existing roof surface.
- D. Where new roof top equipment, pipe vents, and similar roof penetrations occur, install new roofing materials, in strict accordance with original roofing system manufacturer.
- E. Finished work shall be thorough, uniform, neat in appearance and watertight.

3.02 CLEANING

- A. Clean under provisions of Section 01 70 00.

END OF SECTION

SECTION 07 84 13

FIRESTOPPING

PART 1 – GENERAL

1.01 SUMMARY

- A. Related Documents:
The Drawings and general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 Requirements, apply to the work in this Section.

1.02 RELATED SECTIONS

- A. Division 23 – Mechanical
- B. Division 26 – Electrical

1.03 DESCRIPTION OF WORK

- A. The work of this Section consists of the provision of all plant, materials, labor and equipment and the like necessary or required for the complete execution of all firestopping and smoke seal work for this project as required by the schedules, keynotes and drawings, including, but not limited to the following:

NOTE – Firestopping is defined as a material, or combination of materials, to restore the integrity of fire rated walls and floors by maintaining an effective barrier against the spread of flame, smoke and toxic gases.

- 1. Provide firestopping and smoke seals as indicated on the drawings and as required to maintain full and continuous smoke and fire barrier between zones.

Seal all penetrations between floor/ceiling plane with expanding foam. No fiber insulation packing is permitted.

Cope and seal around all structural elements to insure smoke and fire barriers.

- 2. Provide firestopping of all openings in floors and walls both empty and those accommodating penetrating items such as cables and wires, cable trays, conduits, pipes, ducts, etc.; coordinate with Divisions 21, 22, 23 and 26.
- 3. Provide firestopping at joints between curtain walls and floor or roof openings and balance of openings between exterior walls and connecting floor assemblies at each floor.
- 4. Pack expansion joints in fire rated walls and floors;
- 5. Provide firestopping of openings at each floor level in shafts or stairwells.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. E 814 – Standard Method of Fire Tests of Through Penetration Fire Stops.
 - 2. E 119 – Methods of Fire Tests of Building construction and Materials.
 - 3. E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. Underwriters Laboratories, Inc. (UL)
 - 1. UL 1479 – Fire Tests of Through Penetration Fire Stops.
 - 2. UL 263 – Fire Tests of Building Construction and Materials.
 - 3. UL 723 – Surface Burning Characteristics of Building Materials.
 - 4. UL “Fire Resistance Directory” current year.
- C. Factory Mutual (FM) Approval Guide, current year.
- D. Building code of the jurisdiction of the work.
- E. National Fire Protection Association
 - 1. NFPA 101 – Life Safety Code.
 - 2. NFPA 70 – National Electrical Code.

1.05 QUALITY ASSURANCE

- A. Firestopping materials shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E 814 or UL 1479 fire tests.

The F rating and T rating must be a minimum of 1 hour but not less than the fire resistance rating of the assembly being penetrated.

The fire test shall be conducted with a minimum positive pressure differential of 0.03 inches of water column.
- B. Firestopping shall be performed by a Specialty Contractor trained or approved, in writing, by firestop material manufacturer.

Said specialist shall be as defined in the conditions.

Equipment used shall be in accordance with firestop material manufacturer's written installation instructions.
- C. Materials shall conform to all applicable governing codes.
- D. All materials used in the work shall be certified “asbestos free” and shall be free from any and all solvents or components that require hazardous waste disposal or, that after curing, dissolve in water.
- E. All materials shall comply with the interior finish flame spread and smoke developed requirements for the area in which they are installed. Coordinate with governing codes.

1.06 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Certification of specification compliance of all materials.
- C. Manufacturer's printed product data and drawings indicating product characteristics, performance, detail applications and limiting criteria.

Submittal shall include applicable UL and/or FM assembly numbers for each material and proposed installation.
- D. Manufacturer's installation instructions for each type of firestop required by the project.
- E. Manufacturer's approval of nominated installer of firestopping and smoke seal products.
- F. Mockups:
 - 1. Prepare job mockup of the material proposed for use in the project as directed by Architect.
Approved markups shall be left in place as part of the finished project and will constitute and standard for remaining work, including aesthetics.
- G. Manufacturers Material Safety Data Sheet (MSDS) must be submitted for each manufactured product.

1.07 PRODUCT DELIVERY STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Deliver all materials to be used in the work of this section to the project site in original sealed containers with manufacturer's brand and name, lot numbers, UL labeling, mixing and installation instructions clearly identified thereon.
- C. Store all materials in accordance with manufacturer's directions.

All materials shall be dated with shelf life and shall be removed from the project site at the contractor's expense if date is expired.

1.08 PROJECT CONDITIONS

- A. Conform to manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.
- B. Coordinate work required with work of other trades; firestopping shall, where practical, precede gypsum board or other applied sheet finishing operations.
- C. Where firestopping is installed at locations which will remain exposed in the finished work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as required against damage from other construction operations.

- D. Adhesive and sealants use in the building interior [i.e., inside the exterior moisture barrier] shall not exceed VOC content limits of:
 - 1. Provisions of 01 81 10 Environmental Impact of Materials.
 - 2. Aerosol Adhesives: Green Seal Standard GC-36.

1.09 PREINSTALLATION CONFERENCE

- A. A preinstallation conference shall be scheduled in accordance with Section 01 31 00 by the contractor with this specialty contractor and all other specialty contractors, subcontractor and the like to establish procedures to maintain optimum working conditions and to coordinate the work of this section with related and adjacent work.

1.10 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements, and comply with the following:
 - 1. Coordinate work of this section with similar work being performed by certain trades for their own work.
 - 2. All firestop work not performed by trades shall be performed under this section.
 - 3. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
 - 4. Notify the Architect at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
 - 5. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until the Architect and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 – PRODUCTS

2.01 SPECIFICATION STANDARD: For purposes of establishing standards of quality and levels of performance and not for the purposes of limiting competition, the basis of this specification is upon units as manufactured by one of the following and their respective model suitable for the intended application.

- A. Bio Fireshield, Inc.; Damonmill Square, Concord, MA 01742.
 - 1. Novasit K-10 Firestop Mortar
 - 2. K-2 Firestop Mortar
 - 3. Biotherm Firestop Sealants and Caulk
 - 4. Firestop Sleeve
 - 5. Firestop Pillows
 - 6. Biostop 500 Intumescent Caulk
- B. IPC Corp.
 - 1. KBS Mortar Seal
 - 2. Flamesafe Sealants and Caulk
 - 3. FPS 1000 Putty and 1077 Putty Pads
 - 4. Firestop Kits – FSK200
 - 5. KBS Seal Bags

6. Quelpyre Tapes and Blankets
- C. Dow Corning
 1. Firestop Sealant #2000
 2. Firestop Foam #2001
- D. 3M Corporation
 1. Fire Barrier Caulk, CP-25WB
 2. Fire Barrier MPS-2 Putty and 4S Putty Pads
 3. Fire Barrier Intumescent Wrap Strip #FS-195
- E. Nelson Firestop Products
 1. FSP Firestop Putty
 2. CMP Firestop Compound
 3. CLK Firestop Sealant
 4. PLW intumescent Pillow
 5. PCS Preformed Collar for Plastic Pipe Penetrations
 6. MPS Multi-Plug
 7. MCT Multi-Cable Transit
 8. EMCT Multi-Cable Transit and Plug
 9. CTG Firestop Coating
 10. CPS Composite Sheet
- F. Tremco, Inc.
 1. Fyre-Sil and Fyre-Sil SL
 2. Fyre-Shield
 3. THC-900/901
 4. Dymeric, Dymonic Sealant Systems
 5. Compatible forming systems.
- G. General Electric
 1. Pensil 100 Sealant
 2. Pensil 200 Foam
 3. Pensil 300 Joint Sealant
 4. Pensil 500 Putty
 5. Compatible forming systems.
- H. U.S. Gypsum Company
 1. U.S.G. "Thermafiber" unfaced safin insulation with third party wrap, 3.5 pcf density, UL R-10905 label.
 2. U.S.G. "Firecode" compound.
- I. Hilti Corporation
 1. Hilti CP 645 insulated firestop sleeve to replace existing pipe insulation

2.02 ACCESSORY ELEMENTS

- A. Forming, damming materials shall be mineral fiber board or other suitable material recommended by nominated system manufacturer.

- B. Primers, sealant and solvent cleaners shall be as recommended by the nominated system manufacturer.
- C. Metal Systems – 20 gauge phosphatized, electrogalvanized steel plate or galvanized steel clips.

PART 3 – EXECUTION

3.01 INSPECTION AND ACCEPTANCE

- A. Examine all surfaces and contiguous elements to receive work of this section and correct, as part of the work of this contract, any defects affecting installation.
- B. Commencement of work will be construed as complete acceptability of surfaces and contiguous elements.

3.02 PREPARATION

- A. The surface shall be dry, clean, and free of all foreign matter.
- B. Do not apply firestopping to surfaces previously painted or treated with a sealer, curing compound, water repellant or other coatings unless tests have been performed to ensure compatibility of materials.
- C. Provide primers as required which conform to manufacturer's recommendations for various substrates and conditions.
- D. Mask where necessary to protect adjoining surfaces.
- E. Remove excess material and stains on surfaces as required.

3.03 INSTALLATION – GENERAL SYSTEMS

- A. Install in strict accordance with manufacturer's printed instructions.
- B. Ensure that anchoring devices, backup materials, clips, sleeves, supports and other materials used in the actual fire test are installed.
- C. Install firestopping with sufficient pressure to properly fill and seal openings to ensure an effective smoke seal.
- D. Tool or trowel exposed surfaces. Remove excess firestop material promptly as work progresses and upon completion.
- E. Install dams when required to properly contain firestopping materials within openings and as required to achieve required fire resistance ratings. Combustible damming materials must be removed after appropriate curing. Incombustible damming materials may be left as a permanent component of the firestopping systems.

3.04 FIRESTOPPING CONSTRUCTION AT BUILDING EXTERIOR PERIMETERS, INTERIOR WALLS, SHAFTS, ETC.

- A. Install material of proper size on continuous plates or clips as required for proper support in order to safe-off area between exterior walls, interior walls and shafts and floor slabs, said walls and roof areas leaving NO VOIDS.
- B. Firestopping is required at all juncture conditions whether or not clips, angles or other structural elements exist either intermittently or continuously.
- C. Attach plates and clips to floor levels and other breaks and extend through framing to sheathing or other solid strata.
- D. Where metal decking flutes, either parallel or perpendicular to walls, occur and are open, same shall be fully packed and sealed with proper firestopping system.
- E. Where firestopping is accomplished after installation of drywall or other applied sheet finish, all spaces between penetrations and finish shall be filled to the thickness of said sheet finish with intumescent caulk.
- F. At all linear openings, fill voids with a minimum of 6 inches of minimum 3.5 lb./cu. ft. density safing insulation as specified in Part 2 herein and cover entire surface with UL listed firestop sealant of one of nominated manufacturers identified in Part 2 herein.

3.05 PENETRATION SEALS

- A. Penetrations are defined as conduits, cables, wires, piping, ducts or other elements passing through one through one or both outer surfaces of fire rated walls, floors or partitions and shall be firestopped on both sides of penetration in accordance with requirements set forth in Paragraph 1.04 of this Section.
- B. Where sleeves are used, same shall be as specified in Part 2 herein; in event that sleeves are not used, core openings and caulk penetrating items with intumescent system the full length of penetration and seal on both sides with intumescent caulk.
- C. Residual openings within square or rectangular holes shall be filled with compounds applicable for substrate encountered and all penetrations sealed on both sides with caulk.
- D. Where existing pipes penetrate new partition, replace existing pipe insulation with new insulated firestop sleeve and seal perimeter of remaining opening on both sides with caulk.

3.06 FIELD QUALITY CONTROL

- A. Contractor shall immediately notify the Architect if the firestopping systems herein specified cannot meet the requirements of the specification.
- B. Contractor shall examine firestops to ensure proper installation and full compliance with this specification.
- C. All areas of work must be accessible until inspection by the applicable code authorities.

SECTION 089100
LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 230923 - Direct-Digital Control System for HVAC: Actuators for operable louvers.
- B. Section 230943 - Pneumatic Control System for HVAC: Actuators for operable louvers.
- C. Section 233700 - Air Outlets and Inlets: Louvered penthouse.
- D. Section 284600 - Fire Detection and Alarm: Smoke control connection.

1.03 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2015.
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Louvers:
 - 1. Airline Louvers; [____]: www.airlinelouvers.com/#sle.
 - 2. Airolite Company, LLC; [____]: www.airolite.com/#sle.
 - 3. Ruskin; [____]: www.ruskin.com/#sle.

2.02 LOUVERS

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
 - 1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf (of 1.2 kPa) without damage or permanent deformation.
 - 2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft (3.1 g/sq m) water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
 - 3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
 - 4. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.
 - 5. Hinged Units: Provide secondary frame to which louver frame is attached; non-ferrous hinges.

END OF SECTION

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SECTION 230130.51
HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components.

1.02 RELATED REQUIREMENTS

- A. Section 014000 - Quality Requirements: Additional requirements for testing and inspection agencies.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Above-ceiling plenum for supply air is required to be cleaned.
 - 2. Above-ceiling plenum for return air is required to be cleaned.
 - 3. Makeup air system is required to be cleaned.
 - 4. Exhaust-only system is required to be cleaned.
 - 5. ONLY SYSTEMS THAT ARE GOING TO BE REUSED ARE REQUIRED TO BE CLEANED. .

1.04 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- B. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System 2021.
- C. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
- D. UL 181A - Closure Systems for Use with Rigid Air Ducts Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Project Cleanliness Evaluation and Cleaning Plan, as specified.
- D. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- E. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: No existing system documentation is available.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.

- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

2.02 REPLACEMENT PRODUCTS

- A. Fibrous Glass Insulation: Provide material complying with UL 181 equivalent to existing material in quality and thickness.

2.03 SURFACE TREATMENTS

- A. Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.
- B. Surface Coating for Fibrous Glass Materials: Water-based, zero VOC; flame spread index less than 25, smoke developed index less than 450, Class A, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Take precautions to prevent introduction of additional hazards into occupied spaces.
- E. Obtain Owner's approval of proposed temporary locations for large equipment.
- F. Designate a decontamination area and obtain Owner's approval.
- G. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- H. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 EXAMINATION

- A. Prior to the commencement of any cleaning work, prepare and submit to Architect and AGE ENGINEER OF RECORD a project evaluation and plan for this project, including considerations recommended in NADCA ACR.
- B. Inspect the system as required to determine appropriate methods, tools, equipment, and protection.
- C. Start of cleaning work constitutes acceptance of existing conditions.
- D. When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.
- E. Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

3.03 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.

2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
 3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.04 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.
- G. Fibrous Glass Material: Use HEPA vacuuming equipment, under constant negative pressure, do not permit to get wet, and do not damage surfaces; replace material damaged by cleaning operations.
- H. Existing Damaged Fibrous Glass Material: Report to Architect all evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture that cannot be remedied by cleaning or resurfacing with an acceptable insulation repair coating.
 1. Material with active fungal growth is considered irremediable.
 2. Remove irremediable material and clean underlying surfaces.
 3. Where surface damage can be repaired by applying a coating, do so at no extra cost to Owner.
 4. Replace irremediable material.
- I. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- J. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.05 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.06 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.

- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.07 ANTI-MICROBIAL TREATMENT

- A. When directed, apply anti-microbial treatment to internal surfaces.
- B. Apply anti-microbial agent after removal of surface deposits and debris.
- C. Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.
- D. Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

3.08 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.09 WASTE MANAGEMENT

- A. Double-bag waste and debris in 6 mil, 0.006 inch (0.1524 mm) thick polyethylene plastic bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION

SECTION 230517
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) 2016.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- C. UL (DIR) - Online Certifications Directory Current Edition.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- D. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.

2.02 PIPE-SLEEVE SEALS

- A. Modular Mechanical Sleeve-Seal:
 - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 - 3. Size and select seal component materials in accordance with service requirements.
 - 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. Fire Resistant: 1 hour, UL (DIR) approved.
 - e. High Temperature, up to 400 degrees F (204 degrees C).
 - f. Low temperature, down to minus 67 degrees F (minus 55 degrees C).
 - 5. Glass-reinforced plastic pressure end plates.
- B. Sealing Compounds:
 - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 - 2. Combined packing and seal compound is to match partition fire-resistance hourly rating.
- C. Pipe Sleeve Material:

1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
2. Masonry Structures: Sheet metal or fiber.
- D. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.
- E. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch (76.2 mm) thick.
- F. Pipeline-Casing Seals:
 1. Coated boltless casing-spacer for 4 inch (100 mm) carrier pipe.
 2. Coated boltless modular seal for 6 inch (150 mm) carrier pipe.
 3. Carbon steel band with risers for 12 inch (305 mm) carrier pipe.
 4. End Seals: 1/8 inch (3.1 mm), pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations:
 1. Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, partitions, and [_____]. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber in compliance with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.

- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping 2014 (Reapproved 2020).
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2018).
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- G. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2018.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2021.
- J. MFMA-4 - Metal Framing Standards Publication 2004.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
- L. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of [____]. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 1. Manufacturers:
 - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
 - 2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

3. Comply with MFMA-4.
4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
6. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
- C. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Channel Material: Use polyester resin or vinyl ester resin.
 2. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
- D. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch (13 mm) diameter.
 - b. Piping up to 1 inch (27 mm) nominal: 1/4 inch (6 mm) diameter.
 - c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch (10 mm) diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch (10 mm) diameter.
- E. Steel Cable:
- F. Thermal Insulated Pipe Supports:
 1. General Construction and Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch (12.7 mm to 762 mm) iron pipes.
 - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
 - b. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - c. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - d. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - e. Thickness: 60 mil (1.524 mm).
 3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- G. Pipe Supports:
 1. Liquid Temperatures Up To 122 degrees F (50 degrees C):
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 2. Operating Temperatures from 122 to 446 degrees F (50 to 230 degrees C):
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
 - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 Types 35 through 38.
- H. Pipe Stanchions: For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
- I. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.

1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- J. Riser Clamps:
 1. Provide copper plated clamps for copper tubing support.
 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
- K. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- L. Strut Clamps: Two-piece pipe clamp.
- M. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.
- N. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- O. Nonmetallic Pipe Hangers:
- P. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
 1. Pipe Diameter 6 inches (150 mm) and Smaller: Provide minimum clearance of 0.16 inch (4 mm).
 2. Pipe Diameter 8 inches (200 mm): Provide U-bolts with double nuts providing minimum clearance of 0.28 inch (7 mm).
 3. Pipe Diameter 8 inches (200 mm): 0.625 inch (16 mm) U-bolt.
 4. Pipe Diameter 10 inches (250 mm): 0.75 inch (19 mm) U-bolt.
 5. Pipe Diameter 12 to 16 inches (300 to 400 mm): 0.875 inch (24 mm) U-bolt.
 6. Pipe Diameter 18 to 30 inches (450 to 750 mm): 1 inch (25 mm) U-bolt.
- Q. Pipe Alignment Guides: Galvanized steel.
 1. Pipe Diameter 8 inches (200 mm) and Smaller: Spider or sleeve type.
 2. Pipe Diameter 10 inches (250 mm) and Larger: Roller type.
- R. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- S. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 3. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
- T. Pipe Shields for Insulated Piping:
 1. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch (321 mm).
 - d. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - e. Maximum Service Temperature: 178 degrees F (81 degrees C).
 - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- U. Anchors and Fasteners:
 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 4. Hollow Masonry: Use toggle bolts.
 5. Hollow Stud Walls: Use toggle bolts.
 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 7. Sheet Metal: Use sheet metal screws.

8. Wood: Use wood screws.
 9. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
- V. Pipe Installation Accessories:
1. Copper Pipe Supports:
 2. Thermal Insulated Pipe Supports:
 3. Overhead Pipe Supports:
 4. Plenum Pipe Supports:
 5. Telescoping Pipe Supports:
 6. Inserts and Clamps:

2.02 RETROFIT PIPING COVER SYSTEM

- A. General Requirements:
1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.
- B. Materials:
1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
 2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
 3. Unit Length: 7.5 feet (2.29 m).
 4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
 5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.

J. Remove temporary supports.
END OF SECTION

SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.
- D. Vibration-isolated and/or seismically engineered roof curbs.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
- D. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet (15.2 m) of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 - c. For piping over 2 inch (50 mm) located below or within 50 feet (15.2 m) of noise-sensitive areas indicated.
 - 2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
 - b. Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.
 - 3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
 - 4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
 - 5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
- E. Thrust Restraint Applications:
 - 1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg (0.5 kPa) or greater total static pressure.
 - 2. Minimum Static Deflection: Same as static deflection of equipment.
 - 3. Limit lateral movement to 0.25 inch (6 mm) or less unless otherwise indicated.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

- A. Vibration-Isolated Structural Steel Bases:
 - 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 - 2. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
- B. Vibration-Isolated Concrete Inertia Bases:
 - 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 - 2. Minimum Base Depth: 6 inches (152 mm).
 - 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
 - 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
 - 5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 033000.
 - 6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
 - 7. Pump Applications: Size and configure bases for piping elbow supports as required.

2.03 VIBRATION ISOLATORS

- A. General Requirements:
 - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 - 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
- B. Vibration Isolators for Nonseismic Applications:
 - 1. Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
 - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.

2.04 ACOUSTICAL AND VIBRATION ISOLATORS

- A. General Requirements:
 - 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.05 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

- A. Vibration Isolation Curbs:
 - 1. Nonseismic Curb Rail:
 - a. Location: Between existing roof curb and rooftop equipment.
 - b. Construction: Aluminum.
 - c. Integral vibration isolation to comply with requirements of this section.
 - d. Weather exposed components consist of corrosion resistant materials.
 - 2. Nonseismic Curb:
 - a. Location: Between structure and rooftop equipment.
 - b. Construction: Aluminum.
 - c. Integral vibration isolation to comply with requirements of this section.
 - d. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Thrust Restraints:
 - a. Adjust restraint movement under normal operating static pressure.
 - 5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 - 6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 - 7. Adjust isolators to be free of isolation short circuits during normal operation.
 - 8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- D. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.
- C. Field quality-control testing of Laboratory fume hoods.
- D. Measurement of final operating condition of HVAC systems.
- E. Sound measurement of equipment operating conditions.
- F. Vibration measurement of equipment operating conditions.
- G. Commissioning activities.

1.02 RELATED REQUIREMENTS

- A. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 230800 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect, AGE ENGINEER OF RECORD.
 - 2. Include at least the following in the plan:
 - a. Preface: An explanation of the intended use of the control system.
 - b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - g. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
6. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Project altitude.
 - j. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 3. SMACNA (TAB).
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 2. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire and volume dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
 12. Hydronic systems are flushed, filled, and vented.
 13. Pumps are rotating correctly.
 14. Proper strainer baskets are clean and in place.

- 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 FUME HOOD TESTING (ON SITE) CONFIRM WITH AGE/ ARCHITECT AND OWNER

- A. General: Test fume hoods as installed to assess airflow velocity, airflow visualization, and level of containment. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for 100% of the hoods provided in the Project.
- B. Preparation: Visit the project site to confirm that construction activities related to the fume hood system(s) and equipment are complete. Review design documents and Contractor's submittals. Verify that mechanical ventilation systems serving the space are functioning and operating in the normal mode. Notify Owner in writing, if conditions exist which preclude proper fume hood testing. Starting of testing constitutes acceptance of site conditions.
- C. Testing Requirements:
 - 1. Perform the following tests, in order:
 - a. Airflow Velocity Test.
 - b. Airflow Visualization Test.
 - c. Tracer Gas Containment Test.
 - 2. Airflow Velocity Test: Comply with Section 9 of NEBB (FHT) Fume Hood Testing Standard - current edition.
 - 3. Airflow Visualization Test: Comply with Section 10 of NEBB (FHT) Fume Hood Testing Standard - current edition.
 - 4. Tracer Gas Containment Test:
 - a. Comply with Section 11 of NEBB Fume Hood Testing Standard - current edition.

3.07 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- O. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.08 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.09 COMMISSIONING

- A. See Sections 019113 - General Commissioning Requirements and 230800 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
 - 2. Water side systems.
- D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

- E. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for [] percent of the air handlers plus a random sample equivalent to [] percent of the final TAB report data as directed by Commissioning Authority.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - c. Temperatures: Deviation of more than one degree F (0.5 degree C).
 - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- F. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
 - 3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.10 SCOPE

- A. Test, adjust, and balance the following:
 - 1. HVAC Pumps.
 - 2. Air Cooled Water Chillers.
 - 3. Induced Draft Cooling Tower.
 - 4. Blow Through Cooling Tower.
 - 5. Air Cooled Refrigerant Condensers.
 - 6. Packaged Roof Top Heating/Cooling Units.
 - 7. Packaged Terminal Air Conditioning Units.
 - 8. Unit Air Conditioners.
 - 9. Air Coils.
 - 10. Terminal Heat Transfer Units.
 - 11. Induction Units.
 - 12. Air Handling Units.
 - 13. Fans.
 - 14. Air Filters.
 - 15. Air Terminal Units.
 - 16. Air Inlets and Outlets.
 - 17. Controls Compressor.

3.11 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer.

2. Model/Frame.
 3. HP/BHP.
 4. Phase, voltage, amperage; nameplate, actual, no load.
 5. RPM.
 6. Service factor.
 7. Starter size, rating, heater elements.
 8. Sheave Make/Size/Bore.
- B. V-Belt Drives:
1. Identification/location.
 2. Required driven RPM.
 3. Driven sheave, diameter and RPM.
 4. Belt, size and quantity.
 5. Motor sheave diameter and RPM.
 6. Center to center distance, maximum, minimum, and actual.
- C. Pumps:
1. Identification/number.
 2. Manufacturer.
 3. Size/model.
 4. Impeller.
 5. Service.
 6. Design flow rate, pressure drop, BHP.
 7. Actual flow rate, pressure drop, BHP.
 8. Discharge pressure.
 9. Suction pressure.
 10. Total operating head pressure.
 11. Shut off, discharge and suction pressures.
- D. Air Cooled Condensers:
1. Identification/number.
 2. Location.
 3. Manufacturer.
 4. Model number.
 5. Serial number.
 6. Entering DB air temperature, design and actual.
 7. Leaving DB air temperature, design and actual.
 8. Number of compressors.
- E. Chillers:
1. Identification/number.
 2. Manufacturer.
 3. Capacity.
 4. Model number.
 5. Serial number.
 6. Evaporator entering water temperature, design and actual.
 7. Evaporator leaving water temperature, design and actual.
 8. Evaporator pressure drop, design and actual.
 9. Evaporator water flow rate, design and actual.
 10. Condenser entering water temperature, design and actual.
 11. Condenser pressure drop, design and actual.
 12. Condenser water flow rate, design and actual.
- F. Cooling Tower:
1. Tower identification/number.
 2. Manufacturer.

3. Model number.
 4. Serial number.
 5. Rated capacity.
 6. Entering air WB temperature, specified and actual.
 7. Leaving air WB temperature, specified and actual.
 8. Ambient air DB temperature.
 9. Condenser water entering temperature.
 10. Condenser water leaving temperature.
 11. Condenser water flow rate.
 12. Fan RPM.
- G. Cooling Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Entering air DB temperature, design and actual.
 7. Entering air WB temperature, design and actual.
 8. Leaving air DB temperature, design and actual.
 9. Leaving air WB temperature, design and actual.
 10. Water flow, design and actual.
 11. Water pressure drop, design and actual.
 12. Entering water temperature, design and actual.
 13. Leaving water temperature, design and actual.
 14. Saturated suction temperature, design and actual.
 15. Air pressure drop, design and actual.
- H. Heating Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Water flow, design and actual.
 7. Water pressure drop, design and actual.
 8. Entering water temperature, design and actual.
 9. Leaving water temperature, design and actual.
 10. Entering air temperature, design and actual.
 11. Leaving air temperature, design and actual.
 12. Air pressure drop, design and actual.
- I. Air Moving Equipment:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Arrangement/Class/Discharge.
 6. Air flow, specified and actual.
 7. Return air flow, specified and actual.
 8. Outside air flow, specified and actual.
 9. Total static pressure (total external), specified and actual.
 10. Inlet pressure.
 11. Discharge pressure.
 12. Sheave Make/Size/Bore.

13. Number of Belts/Make/Size.
14. Fan RPM.
- J. Return Air/Outside Air:
 1. Identification/location.
 2. Design air flow.
 3. Actual air flow.
 4. Design return air flow.
 5. Actual return air flow.
 6. Design outside air flow.
 7. Actual outside air flow.
 8. Return air temperature.
 9. Outside air temperature.
 10. Required mixed air temperature.
 11. Actual mixed air temperature.
 12. Design outside/return air ratio.
 13. Actual outside/return air ratio.
- K. Exhaust Fans:
 1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.
- L. Duct Traverses:
 1. System zone/branch.
 2. Duct size.
 3. Area.
 4. Design velocity.
 5. Design air flow.
 6. Test velocity.
 7. Test air flow.
 8. Duct static pressure.
 9. Air temperature.
 10. Air correction factor.
- M. Duct Leak Tests:
 1. Description of ductwork under test.
 2. Duct design operating pressure.
 3. Duct design test static pressure.
 4. Duct capacity, air flow.
 5. Maximum allowable leakage duct capacity times leak factor.
 6. Test apparatus:
 - a. Orifice, tube size.
 - b. Orifice size.
 - c. Calibrated.
 7. Test static pressure.
 8. Test orifice differential pressure.

9. Leakage.
- N. Air Monitoring Stations:
 1. Identification/location.
 2. System.
 3. Size.
 4. Area.
 5. Design velocity.
 6. Design air flow.
 7. Test velocity.
 8. Test air flow.
- O. Flow Measuring Stations:
 1. Identification/number.
 2. Location.
 3. Size.
 4. Manufacturer.
 5. Model number.
 6. Serial number.
 7. Design Flow rate.
 8. Design pressure drop.
 9. Actual/final pressure drop.
 10. Actual/final flow rate.
 11. Station calibrated setting.
- P. Terminal Unit Data:
 1. Manufacturer.
 2. Type, constant, variable, single, dual duct.
 3. Identification/number.
 4. Location.
 5. Model number.
 6. Size.
 7. Minimum static pressure.
 8. Maximum design air flow.
 9. Maximum actual air flow.
 10. Inlet static pressure.
- Q. Air Distribution Tests:
 1. Air terminal number.
 2. Room number/location.
 3. Terminal type.
 4. Terminal size.
 5. Area factor.
 6. Design velocity.
 7. Design air flow.
 8. Test (final) velocity.
 9. Test (final) air flow.
 10. Percent of design air flow.
- R. Sound Level Reports:
 1. Location.
 2. Octave bands - equipment off.
 3. Octave bands - equipment on.
- S. Vibration Tests:
 1. Location of points:
 - a. Fan bearing, drive end.

- b. Fan bearing, opposite end.
 - c. Motor bearing, center (if applicable).
 - d. Motor bearing, drive end.
 - e. Motor bearing, opposite end.
 - f. Casing (bottom or top).
 - g. Casing (side).
 - h. Duct after flexible connection (discharge).
 - i. Duct after flexible connection (suction).
- 2. Test readings:
 - a. Horizontal, velocity and displacement.
 - b. Vertical, velocity and displacement.
 - c. Axial, velocity and displacement.
 - 3. Normally acceptable readings, velocity and acceleration.
 - 4. Unusual conditions at time of test.
 - 5. Vibration source (if non-complying).

END OF SECTION

SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Insulation jackets.

1.02 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.
- E. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation 2020.
- G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) 2019.
- H. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings 2019.
- I. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers 2015.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2021.
- L. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K (Ksi) value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 1200 degrees F (649 degrees C).
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure sensitive tape.

- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Indoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Outdoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- G. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter (1.29 mm diameter).

2.03 JACKETS

- A. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
- B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square (2.45 kg/sq m).
- C. Aluminum Jacket: ASTM B209 (ASTM B209M).
 - 1. Thickness: 0.016 inch (0.40 mm) sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
- D. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.
 - 1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
 - 2. Thickness: 34 mils (0.86 mm).
 - 3. Finish: Embossed.
 - 4. Color: Silver.
 - 5. Water Vapor Transmission: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
 - 6. Mold Resistance: Pass when tested in accordance with ASTM C1338.
 - 7. Emissivity: 0.30 when tested in accordance with ASTM C1371.

2.04 DUCT LINER

- A. Note: Choose the liner type - Elastomeric Foam or Glass Fiber.
- B. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
 - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 2. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - 3. Fungal Resistance: No growth when tested according to ASTM G21.
 - 4. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F (0.045 at 24 degrees C).
 - 5. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch (13 mm) Thickness: 0.30.
 - b. 1 inch (25 mm) Thickness: 0.40.
 - c. 1-1/2 inches (40 mm) Thickness: 0.50.
 - d. 2 inch (50 mm) Thickness: 0.60.
 - 6. Erosion Resistance: Does not show evidence of breaking away, flaking off, or delamination at velocities of 10,000 fpm (50.8 m/s) per ASTM C1071.
 - 7. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with ASTM C916.
- D. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
 - 1. Fungal Resistance: No growth when tested according to ASTM G21.
 - 2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F (0.045 at 24 degrees C).

3. Service Temperature: Up to 250 degrees F (121 degrees C).
4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm (25.4 m/s), minimum.
5. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch (13 mm) Thickness: 0.30.
 - b. 1 inch (25 mm) Thickness: 0.45.
 - c. 1-1/2 inches (40 mm) Thickness: 0.60.
 - d. 2 inch (50 mm) Thickness: 0.70.

E. Adhesive: Waterproof, fire-retardant type, ASTM C916.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

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

END OF SECTION

**SECTION 230716
HVAC EQUIPMENT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Equipment insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Covering.

1.02 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- E. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- F. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) 2016.
- G. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- H. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service 2020.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2021.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible.
 - 1. K (Ksi) Value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F (232 degrees C).
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- B. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 1. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - 2. Secure with self-sealing longitudinal laps and butt strips.
- C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

2.03 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

- A. Insulation: ASTM C553 Type V; flexible, noncombustible.
 - 1. Comply with ASTM C1695.

2. K (Ksi) Value: 0.37 at 100 degrees F (0.053 at 38 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
3. Minimum Service Temperature: 32 degrees F (0 degrees C).
4. Maximum Service Temperature: 500 degrees F (260 degrees C).
5. Maximum Water Vapor Absorption: Less than 5.0 percent by weight.
6. Color: Green.
7. Weight: 7.65 oz per sq ft (2334.4 g per sq m).
8. Effective Thickness: 1.25 plus/minus 0.25 inch (0.032 plus/minus 0.0064 m).

2.04 GLASS FIBER, RIGID

- A. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
 1. K (Ksi) Value: 0.25 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
 4. Maximum Density: 8.0 lb/cu ft (128 kg/cu m).
- B. Vapor Barrier Jacket:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 3. Secure with self-sealing longitudinal laps and butt strips.
 4. Secure with outward clinch expanding staples and vapor barrier mastic.
- C. Facing: 1 inch (25 mm) galvanized steel hexagonal wire mesh stitched on one face of insulation.

2.05 JACKETS

- A. PVC Plastic:
 1. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil (0.25 mm).
 - e. Connections: Brush on welding adhesive.
- B. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 1. Thickness: 0.016 inch (0.40 mm) sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 4. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature; insulate entire system.
- G. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- H. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches (40 mm) diameter or larger.
 - 2. Shields: Galvanized steel between hangers and inserts.
 - 3. Insert Location: Between support shield and equipment and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Finish insulation at supports, protrusions, and interruptions.
- J. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- K. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

3.03 SCHEDULE

- A. Heating Systems:
- B. Cooling Systems:
 - 1. Pump Bodies:
 - 2. Chiller Cold Surfaces (Not Factory Insulated):

END OF SECTION

SECTION 230719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jackets and accessories.
- D. Engineered wall outlet seals and refrigerant piping insulation protection.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- E. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.
- F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2019.
- G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).
- H. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation 2021.
- I. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).
- J. ASTM D570 - Standard Test Method for Water Absorption of Plastics 1998 (Reapproved 2018).
- K. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces 2008 (Reapproved 2019).
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- M. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2021.
- N. 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 2004 (Reapproved 2012).
- 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 2016).
- P. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.
- Q. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
- R. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials 2013 (Reapproved 2021).
- S. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

- A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 - 1. K (Ksi) Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C).
 - 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 650 degrees F (343 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).
- E. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

2.03 JACKETS

- A. PVC Plastic.
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil (0.25 mm).
 - e. Connections: Brush on welding adhesive.
- B. ABS Plastic:
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - c. Moisture Vapor Permeability: 0.012 perm inch (0.018 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil (0.76 mm).
 - e. Connections: Brush on welding adhesive.
- C. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
- D. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch (0.40 mm) sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
- E. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
 - 1. Thickness: 0.010 inch (0.25 mm).
 - 2. Finish: Smooth.

3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.
- F. Vapor Barrier Membranes: ASTM C1136, Type IX.
 1. Multilayer Laminate Vapor Barrier:
 - a. Provide multilayer laminate with 1.0 mil (0.025 mm) foil, reversible.
 - b. Thickness: 2.4 mil (0.06 mm).
 - c. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 2. Rubberized Asphalt Vapor Barrier:
 - a. Thickness: 30 mil (0.76 mm).
 - b. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/Pa s m), when tested in accordance with ASTM E96/E96M.

2.04 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

- A. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
 1. Wall Outlet Size, Stucco and Masonry Applications: 7-1/2 inch wide by 10 inch high (190.5 mm wide by 254 mm high).
 - a. Elastomeric Sleeve Diameter: 1-11/16 inch (43 mm).
 2. Outlet Cover Color: Gray.
 3. Water Penetration: Comply with ASTM E331.
 4. Air Leakage: Comply with ASTM E283.
 5. Air Permeance: Comply with ASTM E2178.
- B. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
 1. PVC Insulation Cover Color: Black with full-length Velcro fastener.
 2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
 3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
 4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
 5. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.
 6. Carbon Arc Light Exposure: Comply with ASTM G153.
 7. Tensile Strength After UV Exposure and Water Immersion: Comply with ASTM D412.
 8. Water Absorption of Plastics: Comply with ASTM D570.
 9. Adhesive free.

2.05 ACCESSORIES

- A. General Requirements:
 1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
 3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
 4. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:
 1. Corrosion Control Gel:
 - a. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.

- C. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- E. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- F. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.
- H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.
- I. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.
- J. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- K. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

- A. Cooling Systems:
 - 1. Glycol Cooling Supply and Return:
 - 2. Refrigerant Suction:
 - 3. Refrigerant Hot Gas:

END OF SECTION

SECTION 230913
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Control panels.
- B. Control Valves:
 - 1. Ball valves and actuators.
 - 2. Electronic operators.
- C. Pressure independent valves and actuators.
- D. Dampers.
- E. Damper Operators:
 - 1. Electric operators.
- F. Humidistats:
 - 1. Room humidistats.
 - 2. Limit duct humidistats.
- G. Input/Output Sensors:
 - 1. Temperature sensors.
 - 2. Humidity sensors.
 - 3. Static pressure (air pressure) sensors.
 - 4. Equipment operation (current) sensors.
 - 5. Damper position indicators.
 - 6. Carbon dioxide sensors.
- H. Thermostats:
 - 1. Electric room thermostats.
 - 2. Low-limit temperature cutout switch (freezestat).
 - 3. Room thermostat accessories.
 - 4. Outdoor reset thermostats.
 - 5. Fire thermostats.
 - 6. Heating/cooling valve top thermostats.
- I. Time clocks.
- J. Transmitters:
 - 1. Building static pressure transmitters.
 - 2. Pressure transmitters.
 - 3. Air pressure transmitters.
 - 4. Temperature transmitters.
 - 5. Humidity transmitters.
- K. Transducers:
 - 1. Electropneumatic transducers.

1.02 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.
- B. ANSI/FCI 70-2 - Control Valve Seat Leakage 2021.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats 2013.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- F. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA 250, general purpose utility enclosures with enameled finished face panel.
- C. Provide common keying for all panels.

2.03 CONTROL VALVES

- A. Ball Valves and Actuators:
 - 1. Service: Use for brine (30 percent glycol), chilled water, hot water, or steam at 15 to 25 psig (104.4 to 172.4).
 - 2. Flow Characteristic: Include 2-way and 3-way diverting operation configured to fail normally closed (NC).
 - 3. Replacements in Kind: Provide pressure-independent type.
 - 4. Rangeability: 500 to 1.
 - 5. ANSI Rating: Class 150.
 - 6. Leakage: Class IV (0.1 percent of rated capacity) per ANSI/FCI 70-2.
 - 7. Body Size:
 - a. Under 2-1/2 inches (64 mm):
 - 1) Connection: NPT.
 - 2) Materials:
 - (a) Body: Brass.
 - (b) Flanges: Ductile iron.
 - (c) Ball: Chrome-plated brass.
 - (d) Stem: Nickel-plated brass.
 - (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
 - (f) Stem Seal: EPDM O-Rings.
 - (g) Flow Control Disk: Thermoplastic synthetic-resin.
 - b. 2-1/2 inches (64 mm) and Above:
 - 1) Connection Type: Flanged.
 - 2) Materials:
 - (a) Body: Brass.
 - (b) Flanges: Ductile iron.
 - (c) Ball: 300 series stainless steel.
 - (d) Stem: 300 series stainless steel.
 - (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
 - (f) Stem Seal: EPDM O-Rings.
 - (g) Flow Control Disk: Thermoplastic synthetic-resin.
 - c. Service Temperature:
 - 1) Fluid Side: 0 to 284 degrees F (0 to 140 degrees C) liquid or 25 psig (172.4 kPa) steam.
 - 2) Ambient Side: From minus 4 to 122 degrees F (minus 20 to 50 degrees C).
 - 8. Actuator Requirements:
 - a. Assembly: Factory-mounted.
 - b. Input: 0 to 5 VDC configured for proportional control.
 - c. Accessories: Provide with valve position indicator and manual override.
- B. Electronic Operators:
 - 1. Valves shall spring return to normal position as indicated on freeze, fire, or temperature protection.
 - 2. Select operator for full shut off at maximum pump differential pressure.

2.04 DAMPERS

- A. Performance: Test in accordance with AMCA 500-D.
- B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gauge, 0.1046 inch (2.66 mm).
- C. Blades: Galvanized steel, maximum blade size 8 inches (200 mm) wide, 48 inches (1200 mm) long, minimum 22 gauge, 0.0299 inch (0.76 mm), attached to minimum 1/2 inch (13 mm) shafts with set screws.
- D. Blade Seals: Synthetic elastomeric, inflatable, mechanically attached, field replaceable.
- E. Jamb Seals: Spring stainless steel.
- F. Shaft Bearings: Oil impregnated sintered bronze.
- G. Linkage Bearings: Oil impregnated sintered bronze.
- H. Leakage: Less than one percent based on approach velocity of 2000 ft per min (10 m per sec) and 4 inches wg (1.0 kPa).
- I. Maximum Pressure Differential: 6 inches wg (1.5 kPa).
- J. Temperature Limits: Minus 40 to 200 degrees F (Minus 40 to 93 degrees C).

2.05 DAMPER OPERATORS

- A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - 2. Provide one operator for maximum 36 sq ft (3.34 sq m) damper section.
- B. Electric Operators:
 - 1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.

2.06 HUMIDISTATS

- A. Room Humidistats:
 - 1. Throttling Range: Adjustable 2 percent relative humidity.
 - 2. Operating Range: 30 to 80 percent.
 - 3. Maximum Temperature: 110 degrees F (43 degrees C).
 - 4. Cover: Set point indication.
- B. Limit Duct Humidistats:
 - 1. Insertion, two position type.
 - 2. Throttling Range: Adjustable 2 percent relative humidity.
 - 3. Operating Range: 20 to 80 percent.
 - 4. Maximum Temperature: 150 degrees F (65 degrees C).

2.07 INPUT/OUTPUT SENSORS

- A. Temperature Sensors:
 - 1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
 - 2. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F (26 degrees C).
 - 3. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 - 4. Temperature Sensing Device: Compatible with project DDC controllers.
 - 5. Performance Characteristics:
 - a. RTD:
 - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 3) Chilled Water Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 4) All Other Accuracy: Plus/minus 0.75 degrees F (0.42 degrees C) minimum.

- 5) Range: Minus 40 degrees F (Minus 40 degrees C) through 220 degrees F (104.4 degrees C) minimum.
 - b. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F (0.20 degrees C) minimum.
 - 2) Range: Minus 25 degrees F (Minus 13 degrees C) through 122 degrees F (50 degrees C) minimum.
 - 3) Heat Dissipation Constant: 2.7 mW per degree C.
 - c. Temperature Transmitter:
 - 1) Accuracy: 0.10 degree F (0.06 degrees C) minimum or plus/minus 0.20 percent of span.
 - 2) Output: 4 to 20 mA.
 - d. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - 2) Use RTD type sensors for extended ranges beyond minus 30 degrees F (minus 34.4 degrees) to 230 degrees F (114.4 degrees C).
 - 3) Use temperature transmitters in conjunction with RTD's when RTD's are incompatible with DDC controller direct temperature input.
 - e. Wire Resistance:
 - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F (0.56 degrees C) or use temperature transmitter when offset is greater than 1.0 degree F (0.56 degrees C) due to wire resistance.
 - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
 - f. Room Sensors: Locking cover matching the pneumatic thermostats used.
 - g. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
 - h. Immersion Temperature Sensors: A sensor encased in a corrosion-resistant probe with an indoor junction box service entry body.
 - i. Ceiling and Recessed Mount Temperature Sensors: Ceiling-mounted sensor in a low-profile housing.
 - j. Room Security Sensors: Stainless steel cover plate with insulated back and security screws.
 - k. Room Temperature Sensors:
 - 1) Construct for surface or wall box mounting.
 - 2) Provide the following:
 - (a) Setpoint reset slide switch with an adjustable temperature range.
 - (b) Individual heating/cooling setpoint slide switches.
 - (c) Momentary override request push button for activation of after-hours operation.
 - (d) Analog thermometer.
 - l. Room Temperature Sensors with Integral Digital Display:
 - 1) Construct for surface or wall box.
 - 2) Provide a four button keypad with the following capabilities:
 - (a) Indication of space and outdoor temperatures.
 - (b) Setpoint adjustment to accommodate room setpoint, DDC Input/Output Points List, and Sequence of Operation.
 - (c) Display and control fan operation status.
 - (d) Manual occupancy override and indication of occupancy status.
 - (e) Controller mode status.
 - (f) Password enabled setpoint and override modes.
- B. Humidity Sensors:
- 1. Duct Mounted Sensor: Voltage type encased in a die-cast metal, weather-proof housing.
 - a. Input Power, Voltage Type: Class 2; 12-30 VDC/24 VAC, 15mA max.
 - b. Input Power, mA Type: Class 2; Loop powered 12-30 VDC only, 30 mA max.
 - c. Output Voltage Type: 3-wire observed polarity.
 - d. Output mA Type: 2-wire, not polarity sensitive (clipped and capped).
 - e. Humidity:
 - 1) HS Element: Digitally profiled thin-film capacitive.

- 2) Accuracy 1 percent at 10 to 80 percent relative humidity at 77 degrees F (25 degrees C), multi-point calibration, NIST traceable.
 - (a) Plus/minus 1 percent at 20 to 40 percent RH in mA output mode; (multi-point calibration, NIST traceable).
- 3) Scaling: 0 to 100 percent RH.
- f. Temperature Effect:
 - 1) Duct Mounted: Plus/minus 0.18 percent per degree F (Plus/minus 0.10 percent per degree C).
 - 2) Outdoor Mounted: 4 to 20mA version: $(0.0013 \times \%RH \times (T_{\text{degreeC}} - 25))$.
- g. Hysteresis: 1.5 percent typical.
- h. Linearity: Included in accuracy specification.
- i. Reset Rate: 24 hours.
- j. Stability: Plus/minus 1 percent at 68 degrees F (20 degrees C) annually, for two years.
- k. Temperature Monitoring:
 - 1) Temperature Transmitter Output: Digital, 4 to 20mA (clipped and capped) or 0-5V/0-10V output.
 - (a) HO Transmitter Accuracy: Plus/minus 2.3 degrees F (Plus/minus 1.3 degrees C).
 - (b) HD Transmitter Accuracy: Plus/minus 1.0 degree F (Plus/minus 0.5 degrees C).
- l. Operating Environment:
 - 1) Operating Humidity Range: 0 to 100 percent RH noncondensing.
 - 2) Operating Temperature Range: Minus 40 degrees F (Minus 40 degrees C) to 122 degrees F (50 degrees C).
2. Wall Mounted Sensor: Voltage type encased in a plastic housing.
- C. Static Pressure (Air Pressure) Sensors:
 1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
 2. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F (5 to 40 degrees C).
 3. Accuracy: One percent of full scale with repeatability 0.3 percent.
 4. Output: 0 to 5 vdc with power at 12 to 28 vdc.
- D. Equipment Operation (Current) Sensors:
 1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg (0 to 1250 Pa).
 2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi (50 to 400 kPa).
 3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- E. Damper Position Indicators: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 to 100 percent damper travel.
- F. Carbon Dioxide Sensors, Duct and Wall:
 1. General: Provide non-dispersive infrared (NDIR), diffusion sampling CO2 sensors with integral transducers and linear output.
 2. Air Temperature: Range of 32 to 122 degrees F (0 to 50 degrees C).
 3. Relative Humidity: Range of 0 to 95 percent (non-condensing).
 4. Power Input: Class 2; 12 to 30VDC or 24VAC 50/60 Hz; 100mA max.
 5. Calibration Characteristics:
 - a. Automatically compensating algorithm for sensor drift due to sensor degradation.
 - b. Maximum Drift: 2 percent.
 - c. User calibratable with a minimum calibration interval of 5 years.
 6. Construction:
 - a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
 - b. Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
 - c. Housing: High impact plastic.
 7. Optional Equipment

- a. Temperature Sensor:
 - 1) Solid state, integrated circuit; Accuracy: Plus/minus 1 degree F (0.5 degrees C); Resolution: 0.2 degrees F (0.1 degrees C); Output Range: 50 to 95 degrees F (10 to 35 degrees C).

2.08 THERMOSTATS

- A. Electric Room Thermostats:
 - 1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
 - 2. Service: Cooling only.
 - 3. Covers: Locking with set point adjustment, with thermometer.
- B. Low-Limit Temperature Cutout Switch (low-limit thermostat or freezestat):
 - 1. Configuration: Digital module tied to sensor-assembly.
 - 2. Sensing Length: 4 feet (1.2 m).
 - 3. Setpoint Adjust: Slider.
 - 4. Switch Type: SPDT, snap-action, form C in dust-protected enclosure.
 - 5. Sensing Range: 15 to 55 degrees F (minus 9 to 13 degrees C).
 - 6. Mounting: Locate on cooling coil intake side.
 - 7. Field Interface: Connect load line-voltage to stater.
 - 8. Electrical Rating: Pilot duty, 125 VA at 125 to 600 VAC.
- C. Room Thermostat Accessories:
 - 1. Thermostat Covers: Brushed aluminum.
 - 2. Insulating Bases: For thermostats located on exterior walls.
 - 3. Thermostat Guards: Metal mounted on separate base.
 - 4. Adjusting Key: As required for device.
 - 5. Aspirating Boxes: Where indicated for thermostats requiring flush installation.
- D. Outdoor Reset Thermostats:
 - 1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
 - 2. Scale range: Minus 10 to 70 degrees F (2 to 35 degrees C).
- E. Fire Thermostats:
 - 1. UL labeled, factory set in accordance with NFPA 90A.
 - 2. Normally closed contacts, manual reset.
- F. Heating/Cooling Valve Top Thermostats:
 - 1. Proportional acting for proportional flow, molded rubber diaphragm, remote bulb liquid filled element, direct and reverse acting at differential pressure to 25 psig (172 kPa), cast housing with position indicator and adjusting knob.

2.09 TIME CLOCKS

- A. Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.
- B. Solid state programmable time control with 5 separate programs, 24 hour battery carry over, duty cycling.

2.10 TRANSMITTERS

- A. Building Static Pressure Transmitters:
 - 1. One pipe, direct acting, double bell, scale range 0.01 to 6.0 inch wg (.0025 to 1.5 kPa) positive or negative, and sensitivity of 0.0005 inch wg (0.125 Pa). Transmit electronic signal to receiver with matching scale range.
- B. Pressure Transmitters:
 - 1. One pipe direct acting indicating type for gas, liquid, or steam service, range suitable for system, proportional electronic output.
- C. Air Pressure Transmitters:
 - 1. General: Provide dry media differential pressure transducers to monitor duct and room pressure.

- a. Media Compatibility: Dry air.
 - b. Input Power: Class 2; 12 to 30 VDC; 2-wire: 20 mA max.
 - c. Output: Field selectable, 2-wire, loop-powered 4 to 20 mA (DC only, clipped and capped).
 - d. Pressure Ranges: 4 and 7, field selectable.
 - e. Response Time:
 - 1) Standard: T95 in 20 seconds.
 - 2) Fast: T95 in 2 seconds.
 - 3) Switch selectable.
 - f. Mode: Switch selectable, unidirectional.
 - g. Display:
 - 1) Signed 3-1/2 digit LCD, indicates pressure.
 - 2) Over-range indicator.
 - h. Proof Pressure (pressure differential): 3 psid (20.6 kPa).
 - i. Burst Pressure (pressure differential): 5 psid (34.5 kPa).
 - j. Accuracy: Plus/minus 1 percent f.s. (full scale) of selected range (combined linearity & hysteresis).
 - k. Temperature Effect (per transmitter size):
 - 1) 1 inch w.c. (250 Pa): 2.0 percent per degree C.
 - 2) 10 inch w.c. (2.5 kPa): 0.01 percent per degree C; (Relative to 25 degrees C) 32 degrees F (0 degrees C) to 122 degrees F (50 degrees C).
 - l. Zero Drift (1-year) (per transmitter size):
 - 1) 1 inch w.c. (250 Pa): 2 percent maximum.
 - 2) 10 inch (2.5 kPa): 0.05 percent maximum.
 - m. Zero adjust: Pushbutton auto-zero and digital input (2-pos terminal block).
 - n. Operating Environment:
 - 1) 32 degrees F (0 degrees C) to 140 degrees F (60 degrees C).
 - 2) 0 to 90 percent RH noncondensing.
 - o. Fittings:
 - 1) Brass barb.
 - 2) 0.24 inches (6.1 mm) outer diameter.
 - 3) UL 94 V-O fire retardant ABS.
- D. Temperature Transmitters:
- 1. One pipe, directly proportional output signal to measured variable, linearity within plus or minus 1/2 percent of range for 200 degrees F (93 degrees C) span and plus or minus 1 percent for 50 degrees F (10 degrees C) span, with 50 degrees F (10 degrees C). temperature range, compensated bulb, averaging capillary, or rod and tube operation on 20 psig (138 kPa) input pressure and 3 to 15 psig (20 to 100 kPa) output.
- E. Humidity Transmitters:
- 1. One pipe, directly proportioned output signal to measured variable, linearity within plus or minus 1 percent for 70 percent relative humidity span, capable of withstanding 95 percent relative humidity without loss of calibration.

2.11 TRANSDUCERS

- A. Electropneumatic Transducers:
- 1. General: Provide electropneumatic pressure transducer utilizing micro-controlled poppet valve technology for pressure sensing in multiple applications.
 - a. Input Power: Class 2; 24 VAC/DC nominal, 30 VAC max; 150 mA max.
 - b. Control Input: Class 2; 4 to 20 mA/0 to 5 V/0 to 10 VDC, jumper-selectable.
 - c. Input Impedance: 4 to 20 mA, 250 ohms; 0 to 5 V/0 to 10 VDC; jumper selectable.
 - d. Manual Override: Jumper-selectable mode, digital pushbutton adjust.
 - e. Alarm Contact: 100 mA at 30 VAC/DC (Pressure loss, manual mode, jumper selectable).
 - f. Accuracy: 1 percent.
 - g. Compensated Temperature Range: 25 degrees F (minus 4 degrees C) to 140 degrees F (65 degrees C).
 - h. Temperature Coefficient: Plus/minus 0.118 percent per degree F (0.05 percent per degree C).
 - i. Operating Environment: 10 to 90 percent RH noncondensing.

- j. Air Capacity:
 - 1) 523 cubic inches per minute (8570 cubic meters per minute) at 45 psi (310.3 kPa).
 - 2) 333 cubic inches per minute (5456 cubic meters per minute) at 20 psi (137.9 kPa).
- k. Supply Pressure: 45 psi (310 kPa).
- l. Control Range: 0 to 20 psi (0 to 138 kPa) or 3 to 15 psi (20.7 to 103.4 kPa).
- m. Pressure Differential: 0.1 psi (0.69 kPa) (supply to branch).
- n. Pressure Indication: Electronic, 3-1/2 digit LCD.
- o. Minimum Tubing Length: 15 ft (4.6 m).
- p. Port Connection: 1/8 inch (3.18 mm) poly tubing.
- q. Media Connection:
 - 1) Clean, dry air, or inert gas.
 - 2) Use with oxygen service is prohibited.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- F. Ensure installation of components is complementary to installation of similar components.
- G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches (1500 mm) above floor. Align with lighting switches and humidistats. See Section 262726.
- C. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 SCHEDULES

- A. Control Valve Schedule
 - 1. Drawing Code
 - 2. Valve Size
 - 3. Valve CV
 - 4. Operator Spring Range
 - 5. Normal Position
- B. Control Damper Schedule
 - 1. Drawing Code
 - 2. Height
 - 3. Width
 - 4. Air Flow
 - 5. Air Pressure Drop

END OF SECTION

SECTION 230993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.
- B. Sequence of operation for:
 - 1. Air terminal units.
 - 2. Cabinet heaters.
 - 3. Central fan systems.
 - 4. Fan coil units.
 - 5. Humidifiers.
 - 6. Refrigeration systems.
 - 7. Unit heaters.

1.02 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
 - 1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
 - 2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in Contract Documents.
 - 3. Include at least the following sequences:
 - a. Start-up.
 - b. Warm-up mode.
 - c. Normal operating mode.
 - d. Unoccupied mode.
 - e. Shutdown.
 - f. Capacity control sequences and equipment staging.
 - g. Temperature and pressure control, such as setbacks, setups, resets, etc.
 - h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - i. Effects of power or equipment failure with all standby component functions.
 - j. Sequences for all alarms and emergency shut downs.
 - k. Seasonal operational differences and recommendations.
 - l. Interactions and interlocks with other systems.
 - 4. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - 5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
 - 6. Include schedules, if known.
- C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
 - 1. Label with settings, adjustable range of control and limits.
 - 2. Include flow diagrams for each control system, graphically depicting control logic.
 - 3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - 4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

5. Include all monitoring, control and virtual points specified in elsewhere.
6. Include a key to all abbreviations.
- D. Points List: Submit list of all control points indicating at least the following for each point.
 1. Name of controlled system.
 2. Point abbreviation.
 3. Point description; such as dry bulb temperature, airflow, etc.
 4. Display unit.
 5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
 6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
 7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
 8. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.
- E. Designer's Qualification Statement.
- F. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 AIR TERMINAL UNITS

- A. Single-duct Variable Volume:
 1. Cooling Only:
 - a. On a rise in space temperature, the damper will modulate to provide maximum airflow.
 - b. As space temperature decreases, the damper will modulate down to its minimum airflow.

3.02 CABINET HEATERS

- A. Single temperature electric room thermostat set at 68 degrees F (20 degrees C) maintains constant space temperature by cycling unit fan motor.
- B. Single temperature thermostat on return heating water line from floor mounted cabinet heaters de-energizes unit on temperatures below 95 degrees F (35 degrees C).
- C. Single temperature room thermostat set at 68 degrees F (20 degrees C) maintains constant space temperature by cycling unit fan motor and electric heating elements.
 1. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (38 degrees C).

3.03 CENTRAL FAN SYSTEMS

- A. Time Schedule: Start and stop supply and return fans. Determine fan status through auxiliary contactors in motor starter. If fan fails to start as commanded, signal alarm.
- B. Safety Devices:
 1. Freeze Protection: Stop fans and close outside air dampers if temperature before supply fan is below 37 degrees F (3 degrees C); signal alarm.
 2. High Temperature Protection: Stop fans and close outside dampers if temperature in return air is above 300 degrees F (150 degrees C); signal alarm.
 3. Smoke Detector: Stop fans, close outside dampers, and close smoke dampers if smoke is detected; signal alarm.
- C. Preheat Coil:
 1. When fan is not running, and outside air temperature is below 40 degrees F (5 degrees C), fully open preheat coil valve to heating.
 2. When fan is running, maintain constant mixed air temperature of 55 degrees F (12 degrees C) by modulating preheat coil valve.
- D. Outside Air Damper: When supply fan is running, open outside air damper to minimum position. Prevent supply fan starting until outside air damper is open and position is verified.
- E. Humidifier: When supply fan is running, allow humidifier to operate.

- F. Humidifier: When supply fan is running and there is water in humidifier sump, humidistat located in return air, reset from outdoors modulates normally closed humidifier valve. Set outdoor reset to 50 percent relative humidity at 70 degrees F (21 degrees C) and 15 percent relative humidity at minus 30 degrees F (minus 35 degrees C).
- G. Outside, Return, and Relief Dampers:
 - 1. When supply fan is not running, outside and relief dampers are closed and return damper is open.
 - 2. When supply fan is running, dampers are controlled and operate with outside and relief dampers opening, and return damper closing.
 - 3. For cooling and outside air temperatures below 55 degrees F (12 degrees C), modulate dampers to maintain mixed air temperature of 55 degrees F (12 degrees C) or higher.
 - 4. For cooling and outside air temperatures above 55 degrees F (12 degrees C) outside and relief dampers are open and return damper is closed.
 - 5. For cooling and outside air temperatures above 55 degrees F (12 degrees C) compare return and outside air temperatures. If return air temperature is lower, drive outside damper to minimum, close relief damper, and open return damper.
 - 6. For outside air temperatures above 79 degrees F (26 degrees C), drive outside damper to minimum, close relief damper, and open return damper.
 - 7. For heating, drive outside damper to minimum, close relief damper, and open return damper.
- H. Modulate mixed air dampers in sequence to maintain constant mixed air temperature.
- I. Multizone System:
 - 1. Space sensor set at 75 degrees F (24 degrees C), modulates zone dampers and maintains constant space temperature during the day and 15 degrees F cooler at night (during the day and 8 degrees C cooler at night).
 - 2. Room calling for greatest heating modulates reheat coil valve. Room thermostat calling for greatest cooling modulates cooling coil valve.
- J. Maintain constant supply static pressure of 1.5 inches wg (380 Pa) by modulating supply and return fan inlet vane dampers in sequence. Locate sensor minimum 50 ft (15 m) downstream of supply fan in supply air duct.
- K. Maintain constant supply static pressure of 1.5 inches wg (380 Pa) by modulating supply fan inlet vane dampers. Maintain constant building pressure of 0.05 inches wg (12 Pa) measured at grade by modulating return air fan inlet vane dampers.
- L. Display:
 - 1. System graphic.
 - 2. System on/off indication.
 - 3. System day/night mode.
 - 4. System fan on/off indication.
 - 5. Return fan on/off indication.
 - 6. Preheat coil pump on/off indication.
 - 7. Spray pump on/off indication.
 - 8. Outside air temperature indication.
 - 9. Mixed air temperature indication.
 - 10. Fan discharge air temperature indication.
 - 11. Reheat zone air temperature indication.
 - 12. Return humidity indication.
 - 13. Fan discharge temperature control point adjustment.
 - 14. Return humidity control point adjustment.
 - 15. Reheat zone control point adjustment.
 - 16. Supply static pressure indication.
 - 17. Supply static pressure control point adjustment.
 - 18. Building static pressure indication.
 - 19. Building static pressure control point adjustment.
 - 20. System on/off auto switch.
 - 21. System day/night/auto switch.
 - 22. Supply fan on/off switch.
 - 23. Return fan on/off/auto switch.
 - 24. Preheat coil pump on/off switch.

25. Spray pump on/off auto switch.

3.04 FAN COIL UNITS

- A. Single temperature unit mounted thermostat set at 75 degrees F (24 degrees C) maintains constant space temperature during the day and 15 degrees F cooler at night (during the day and 8 degrees C cooler at night) by modulating two-way control heating valve with spring range of 3 to 7 psig (with spring range of 20 to 48 kPa).
- B. Single temperature unit mounted thermostat set at 75 degrees F (24 degrees C) maintains constant space temperature during the day and 15 degrees F cooler at night (during the day and 8 degrees C cooler at night) by modulating two-way control heating valve with spring range of 3 to 7 psig (with spring range of 20 to 48 kPa) and two-way cooling control valve with spring range of 8 to 13 psig (with spring range of 55 to 90 kPa) in sequence.
- C. Single temperature unit mounted thermostat set at 75 degrees F (24 degrees C) maintains constant space temperature during the day and 15 degrees F cooler at night (during the day and 8 degrees C cooler at night) by modulating four-way control valve. During heating cycle, modulate hot water supply to coil and divert return modulate chilled water supply to coil and divert return water to cooling return pipe. When space temperature is at thermostat setting, prevent flow from occurring in either circuit and in coil.
- D. Change over from heating to cooling by indexing thermostat from thermostat on supply piping. When supply is above room temperature, operate thermostat in direct acting manner, opening valve when temperature falls below thermostat setting. When supply is below room temperature, operate thermostat in reverse acting manner, opening valve when space temperature rises above thermostat setting.
- E. For heating and cooling fan coil units with fan speed control during heating cycle, increase fan speed as space temperature falls below thermostat setting, provided hot water is available. During cooling cycle, increase fan speed as space temperature rises above thermostat setting, provided chilled water is available.
- F. Mount thermostat with adjustable knob and speed switch on common plate engraved with "Heating Control and Fan Control" on top, with "Warmer and Cooler" and direction indicator around the thermostat knob.

3.05 HUMIDIFIERS

- A. When fan is running and air flow switch proves air flow, line voltage room humidistat reset from outdoors maintains humidity level of 30 percent by cycling unit fan two-way steam valve.
- B. When supply fan is running air flow switch proves air flow, humidistat located in return air, reset from outdoors modulates normally closed humidifier valve. Set outdoor reset to 50 percent relative humidity at 70 degrees F (2 degrees C) and 15 percent relative humidity at minus 30 degrees F (minus 35 degrees C).

3.06 REFRIGERATION SYSTEMS

- A. Maintain constant supply air duct temperature of 55 degrees F (13 degrees C) by cycling refrigeration system and signaling step capacity, minimum of [] steps.

3.07 UNIT HEATERS

- A. Single temperature electric room thermostat maintains constant space temperature of 68 degrees F (20 degrees C) by cycling unit fan motor.
- B. Single temperature thermostat on return heating water line from floor mounted cabinet heaters de-energizes unit on temperatures below 95 degrees F (35 degrees C).
- C. Single temperature room thermostat set at 68 degrees F (20 degrees C) maintains constant space temperature by cycling unit fan motor and energizing electric heating elements.
- D. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (38 degrees C).

END OF SECTION

SECTION 232300
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Filter-driers.

1.02 REFERENCE STANDARDS

- A. AHRI 710 - Performance Rating of Liquid-Line Driers 2009.
- B. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers 2013 (Reapproved 2014).
- C. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants 2019.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.
- E. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes 2018.
- F. ASME B31.5 - Refrigeration Piping and Heat Transfer Components 2020.
- G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.
- J. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service 2020.
- K. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2019.
- L. ICC (IMC)-2018 - International Mechanical Code 2018.
- M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
- N. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

1.03 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
 - 3. Use line size on leaving side of liquid solenoid valves.
- D. Valves:
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gauge taps at compressor inlet and outlet.
 - 3. Use gauge taps at hot gas bypass regulators, inlet and outlet.
 - 4. Use check valves on compressor discharge.
 - 5. Use check valves on condenser liquid lines on multiple condenser systems.

- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
 - 1. Use line size strainer upstream of each automatic valve.
 - 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 - 3. On steel piping systems, use strainer in suction line.
 - 4. Use shut-off valve on each side of strainer.
- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- H. Filter-Driers:
 - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
 - 2. Use a filter-drier on suction line just ahead of compressor.
 - 3. Use sealed filter-driers in lines smaller than 1/2 inch (13 mm) outside diameter.
 - 4. Use sealed filter-driers in low temperature systems.
 - 5. Use sealed filter-driers in systems utilizing hermetic compressors.
 - 6. Use replaceable core filter-driers in lines of 1/2 inch (13 mm) outside diameter or greater.
 - 7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
 - 8. Use filter-driers for each solenoid valve.

PART 2 PRODUCTS

2.01 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
 - 3. Mechanical Press Sealed Fittings: Double pressed type complying with UL 207 and ICC (IMC)-2018.
- B. Copper Tube to 7/8 inch (22 mm) OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.
 - 3. Mechanical Press Sealed Fittings: Double pressed type complying with UL 207 and ICC (IMC)-2018.
- C. Pipe Supports and Anchors:
 - 1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
 - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 4. Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
 - 5. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - 6. Vertical Support: Steel riser clamp.
 - 7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 - 10. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
 - 11. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

- d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
- e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.

2.02 REFRIGERANT

- A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
- B. Refrigerant: R-134a, tetrafluoroethane as defined in ASHRAE Std 34.

2.03 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of 500 psi (3450 kPa).

2.04 VALVES

- A. Diaphragm Packless Valves:
 - 1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).
- B. Packed Angle Valves:
 - 1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).
- C. Ball Valves:
 - 1. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 300 degrees F (149 degrees C).
- D. Service Valves:
 - 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi (3450 kPa).

2.05 STRAINERS

- A. Straight Line or Angle Line Type:
 - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi (2960 kPa).
- B. Straight Line, Non-Cleanable Type:
 - 1. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of [] psi ([] kPa).

2.06 FILTER-DRIERS

- A. Performance:
 - 1. Flow Capacity - Liquid Line: [] ton ([] kW), minimum, rated in accordance with AHRI 710.
 - 2. Flow Capacity - Suction Line: [] ton ([] kW), minimum, rated in accordance with AHRI 730 (I-P).
 - 3. Pressure Drop: 2 psi (14 kPa), maximum, when operating at full connected evaporator capacity.
 - 4. Design Working Pressure: 350 psi (2410 kPa), minimum.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
 - 1. Replaceable Core Type: Steel shell with removable cap.
 - 2. Sealed Type: Copper shell.
 - 3. Connections: As specified for applicable pipe type.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.5.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
- F. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- G. Provide clearance for installation of insulation and access to valves and fittings.

3.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 inch (13 mm), 5/8 inch (16 mm), and 7/8 inch (22 mm) OD: Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6.3 mm).
 - 2. 1-1/8 inch (29 mm) OD: Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6.3 mm).
 - 3. 1-3/8 inch (35 mm) OD: Maximum span, 7 feet (2100 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 4. 1-5/8 inch (41 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 5. 2-1/8 inch (54 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 6. 2-5/8 inch (67 mm) OD: Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 7. 3-1/8 inch (79 mm) OD: Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9.5 mm).
 - 8. 3-5/8 inch (92 mm) OD: Maximum span, 11 feet (3.4 m); minimum rod size, 1/2 inch (12.7 mm).
 - 9. 4-1/8 inch (92 mm) OD: Maximum span, 12 feet (3.6 m); minimum rod size, 1/2 inch (12.7 mm).
- B. Hanger Spacing for Steel Piping.
 - 1. 1/2 inch (15 mm), 3/4 inch (20 mm), and 1 inch (25 mm): Maximum span, 7 feet (2100 mm); minimum rod size, 1/4 inch (6.3 mm).
 - 2. 1-1/4 inches (32 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 3. 1-1/2 inches (40 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 4. 2 inches (50 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9.5 mm).
 - 5. 2-1/2 inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
 - 6. 3 inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9.5 mm).
 - 7. 4 inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (12.7 mm).

END OF SECTION

SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Nonmetal ductwork.
- C. Casings and plenums.
- D. Fire-rated ductwork.
- E. Duct cleaning.

1.02 RELATED REQUIREMENTS

- A. Section 230130.51 - HVAC Air-Distribution System Cleaning: Cleaning ducts after completion of installation.
- B. Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- C. Section 230713 - Duct Insulation: External insulation and duct liner.
- D. Section 233300 - Air Duct Accessories.
- E. Section 233600 - Air Terminal Units.
- F. Section 233700 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- E. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.
- G. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements 2015.
- H. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements 2015.
- I. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2015.
- J. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements 2016.
- K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- L. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.
- M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2020.
- N. SMACNA (FGD) - Fibrous Glass Duct Construction Standards 2021.
- O. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
- P. UL 1978 - Grease Ducts Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

- A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.
- B. Ducts: Galvanized steel, unless otherwise indicated.
- C. Low Pressure Supply (Heating Systems): 1/2 inch wg (125 Pa) pressure class, galvanized steel.
- D. Low Pressure Supply (System with Cooling Coils): 1/2 inch wg (125 Pa) pressure class, galvanized steel.

- E. Medium and High Pressure Supply: 1/2 inch wg (125 Pa) pressure class, galvanized steel.
- F. Return and Relief: 1/2 inch wg (125 Pa) pressure class, galvanized steel.
- G. General Exhaust: 1/2 inch wg (125 Pa) pressure class, galvanized steel.
- H. Outside Air Intake: 1/2 inch wg (125 Pa) pressure class, galvanized steel.
- I. Combustion Air: 1/2 inch wg (125 Pa) pressure class, galvanized steel.
- J. Evaporative Condenser Intake and Exhaust: 1/2 inch wg (125 Pa) pressure class, galvanized steel.
- K. Transfer Air and Sound Boots: 1/2 inch wg (125 Pa) pressure class, fibrous glass.

2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
 - 4. For Use with Flexible Ducts: UL labeled.
- C. Gasket Tape: Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle rings connections.
- D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- E. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 - 6. Other Types: As required.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- C. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- D. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
 - 1. Manufacture in accordance with SMACNA (DCS).
- B. Round Ducts: Round lockseam duct with galvanized steel outer wall.
 - 1. Manufacture in accordance with SMACNA (DCS).
- C. Flexible Ducts: Two-ply vinyl film supported by helically wound spring steel wire.
 - 1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 - 2. Pressure Rating: 10 inches wg (2.50 kPa) positive and 1.0 inches wg (250 Pa) negative.
 - 3. Maximum Velocity: 4000 fpm (20.3 m/sec).
 - 4. Temperature Range: Minus 10 degrees F to 160 degrees F (Minus 23 degrees C to 71 degrees C).

- D. Flexible Ducts: UL 181, Class 1, UV-inhibited black polymer film supported by helically wound spring steel wire.
 - 1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 - 2. Pressure Rating: 10 inches wg (2.50 kPa) positive and 0.5 inches wg (175 Pa) negative.
 - 3. Maximum Velocity: 4000 fpm (20.3 m/sec).
 - 4. Temperature Range: Minus 20 degrees F to 175 degrees F (Minus 28 degrees C to 79 degrees C).
- E. Round Duct Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).
- F. Two-hour, Fire Rated Ducts:
 - 1. UL or ETL labeled.
 - 2. R-Value: 4.5 when tested in accordance with ASTM C177.
- G. Three-hour, Fire Rated Ducts:
 - 1. UL or ETL labeled.
 - 2. Construct of 22 gauge, 0.0299 inch (0.76 mm) galvanized steel.

2.05 CASINGS AND PLENUMS

- A. Fabricate casings in accordance with SMACNA (DCS) and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch (100 mm) high concrete curbs. At floor, rivet panels on 8 inch (200 mm) centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18 gauge, 0.0478 inch (1.21 mm) expanded metal mesh supported at 12 inch (300 mm) centers, turned up 12 inches (300 mm) at sides with sheet metal shields.
- C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
- D. Fire-Rated Metal Panels:
 - 1. Fire Rating: 60 minutes when tested in accordance with ASTM E119.
 - 2. Material: Steel-faced composite panel with noncombustible structural high density mineral fiber core, UL or ETL labeled, nonload bearing fire separations.
 - a. Finish: Unpainted.
 - b. Core: Mineral wool board.
 - c. Structural: Nonload bearing.
 - 3. Panel Thickness: 4 inches (100 mm).
 - 4. Sound Transmission Class: 30 when tested in accordance with ASTM E90.

2.06 FIBROUS GLASS DUCTS

- A. Fibrous Glass Ducts: 1 inch (25 mm) thick rigid glass fiber with aluminum foil, glass scrim and Kraft or plastic jacket vapor barrier; maximum 0.23 K value at 75 degrees F (0.034 KSI at 24 degrees C).
- B. Fabricate in accordance with SMACNA (FGD), except as indicated.
- C. Machine fabricate fibrous glass ducts and fittings. Make only minor on site manual adjustments.
- D. Do not use fibrous glass ducts within 12 inches (300 mm) of electric or fuel fired heaters.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

3.02 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Backdraft dampers - fabric.
- D. Fiberglass backdraft dampers.
- E. Combination fire and smoke dampers.
- F. Combination fire and smoke dampers - corridor dampers.
- G. Duct access doors.
- H. Duct test holes.
- I. Fire dampers.
- J. Smoke dampers.
- K. Volume control dampers.
- L. Low leakage (Class 1A) control dampers.
- M. Miscellaneous products:
 - 1. Damper operators.
 - 2. Damper position switch.
 - 3. Fire-rated enclosures.

1.02 RELATED REQUIREMENTS

- A. Section 233100 - HVAC Ducts and Casings.
- B. Section 253523 - Integrated Automation Control Dampers: Product furnishing.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- C. NFPA 92 - Standard for Smoke Control Systems 2021.
- D. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2020.
- F. UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.
- G. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.
- H. UL 555C - Standard for Safety Ceiling Dampers Current Edition, Including All Revisions.
- I. UL 555S - Standard for Smoke Dampers Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 BACKDRAFT DAMPERS - METAL

- A. Gravity Backdraft Dampers, Size 18 by 18 inches (450 by 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.02 BACKDRAFT DAMPERS - FABRIC

- A. Fabric Backdraft Dampers: Factory-fabricated.
 - 1. Blades: Neoprene coated fabric material.
 - 2. Birdscreen: 1/2 inch (12 mm) nominal mesh of galvanized steel or aluminum.
 - 3. Maximum Velocity: 1000 fpm (5 mps) face velocity.

2.03 FIBERGLASS BACKDRAFT DAMPERS

- A. Fiberglass Material Construction: ASTM E84, flame retardant, vinyl ester based resin.
- B. Counterbalanced assembly, 18 inches (450 mm) round, flanged. Fiberglass-made frame with single butterfly blade. Steel-fabricated axle with graphite-filled PTFE sleeve bearings located out of the airstream, and metal paint finish.
- C. Identification Tag: Custom octagon type, stainless steel, engraved.
 - 1. Information: Show cfm (lps) with fail setting and part number.
 - 2. Fastened: Beaded chain, stainless steel.
- D. Maximum Operating Pressure: 10 in wg (7.5 kPa).
- E. Maximum Temperature Service: 200 degrees F (94 degrees C).

2.04 COMBINATION FIRE AND SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- B. Provide factory sleeve and collar for each damper.
- C. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch (12.7 mm) actuator shaft.
- D. Operators: UL listed and labelled spring return pneumatic type suitable for operation on 0-20 psig (0-140 kPa) instrument air. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
- E. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- F. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.
- G. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.

2.05 COMBINATION FIRE AND SMOKE DAMPERS - CORRIDOR DAMPERS

- A. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- B. Provide factory sleeve and collar for each damper.
- C. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
- D. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- E. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.06 DUCT ACCESS DOORS

- A. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch (25 mm) thick insulation with sheet metal cover.
 - 1. Less Than 12 inches (300 mm) Square: Secure with sash locks.
 - 2. Up to 18 inches (450 mm) Square: Provide two hinges and two sash locks.
 - 3. Up to 24 by 48 inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.

2.07 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.08 FIRE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- B. Ceiling (Radiation) Dampers: Galvanized steel, 22 gauge, 0.0299 inch (0.76 mm) frame and 16 gauge, 0.0598 inch (1.52 mm) flap, two layers 0.125 inch (3.2 mm) ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
 - 1. Rated for three hour service in compliance with UL 555C.
- C. Horizontal Dampers: Galvanized steel, 22 gauge, 0.0299 inch (0.76 mm) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch (250 Pa) pressure class ducts up to 12 inches (300 mm) in height.
- E. Multiple Blade Dampers: 16 gauge, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 160 degrees F (71 degrees C) with adjustable link straps for combination fire/balancing dampers.
- G. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.

2.09 SMOKE DAMPERS

- A. Products furnished per Section 253523.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- C. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- D. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.10 VOLUME CONTROL DAMPERS

- A. Products furnished per Section 253523.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Splitter Dampers:
 - 1. Material: Same gauge as duct to 24 inches (600 mm) size in either direction, and two gauges heavier for sizes over 24 inches (600 mm).
 - 2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
- D. Single Blade Dampers:
 - 1. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
 - 2. Blade: 24 gauge, 0.0239 inch (0.61 mm), minimum.
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch (200 by 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
 - 1. Blade: 18 gauge, 0.0478 inch (1.21 mm), minimum.
- F. End Bearings: Except in round ducts 12 inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

2.11 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

- A. Maximum Leakage Allowed: 3 cfm/sf at 1 inch wg (15.2 lps/sm at 0.25 kPa).

- B. Frame:
 - 1. Material: 12 gauge galvanized steel.
 - 2. Free-area: Single cross section.
 - 3. Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.
- C. Blade:
 - 1. Type: Single-blade rectangle shape.
 - 2. Operation: Opposed type.
 - 3. Maximum Individual Blade Height: 8 inches (203 mm).
 - 4. Material: 12 gauge galvanized steel.
 - 5. Authority: Opposed type, 5 to 50 percent (typically 10 percent).
- D. Insulation: Water-resistant sound absorbing material.
- E. Temperature Service Range: Minus 25 to 185 degrees F (minus 32 to 85 degrees C).
- F. Other Requirements:
 - 1. Paint Finish: Standard.
 - 2. Rust Inhibitor Coating: Moisture and salt water-resistant.
 - 3. Sleeve or Flange: Factory-mounted standard.
 - 4. Duct Transition Fitting: Round.
 - 5. Custom: Include bird screen and insect screen.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch (200 by 200 mm) size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch (100 by 100 mm) for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. Use splitter dampers only where indicated.

END OF SECTION

SECTION 233413
AXIAL HVAC FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Propeller fans.

1.02 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 233300 - Air Duct Accessories: Backdraft dampers.

1.03 FIELD CONDITIONS

- A. Permanent fans may not be used for ventilation during construction.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with resilient mountings and with flexible electrical leads; see Section 230548.
- C. Install flexible connections specified in Section 233300 between axial fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and axial fan while running.
- D. Install fan restraining snubbers; see Section 230548. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

3.02 SCHEDULES

- A. Drawing Code (F-1):
 - 1. Manufacturer:
 - 2. Model:
 - 3. Fan Type:
 - 4. Wheel Type:
 - 5. Class:
 - 6. Arrangement:
 - 7. Size:
 - 8. Air Flow Capacity:
 - 9. Static Pressure:
 - 10. Drive:
 - 11. RPM:
 - 12. Motor hp:

END OF SECTION

SECTION 233423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof exhausters.
- B. Roof ventilators.
- C. Roof intake fans.
- D. Wall exhausters.
- E. Fire-rated enclosures.
- F. Utility vent blowers.
- G. Utility vent blower sets.

1.02 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.
- B. AMCA 99 - Standards Handbook 2016.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carnes, a division of Carnes Company Inc; [____]: www.carnes.com/#sle.
- B. Greenheck Fan Corporation; [____]: www.greenheck.com/#sle.
- C. Loren Cook Company; [____]: www.lorencook.com/#sle.
- D. PennBarry, Division of Air System Components; [____]: www.pennbarry.com/#sle.
- E. Twin City Fan & Blower; [____]: www.tcf.com/#sle.

2.02 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.03 ROOF EXHAUSTERS

- A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch (13 mm) mesh, 0.62 inch (1.6 mm) thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- B. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

- C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.04 WALL EXHAUSTERS

- A. Manufacturers:
 - 1. Carnes, a division of Carnes Company Inc; []: www.carnes.com/#sle.
 - 2. Greenheck Fan Corporation; []: www.greenheck.com/#sle.
 - 3. PennBarry, Division of Air System Components; []: www.pennbarry.com/#sle.
 - 4. Twin City Fan & Blower; WPB: www.tcf.com/#sle.
- B. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch (13 mm) mesh, 0.062 inch (1.6 mm) thick aluminum wire bird screen.
- C. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- D. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.05 ROOF INTAKE FANS

- A. Fan Unit: Adjustable belt or direct-driven forward curved fan, resiliently-mounted induction motor, heavy duty ball bearings, powder-coated steel weatherproof cabinet with side intake hood, and removable service panels.
- B. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.
- C. Operation: On/off using hand-off-auto switch, start/stop button, or VFD.
- D. Service Temperature: Minus 65 to 250 degrees F (Minus 54 to 121 degrees C).
- E. Accessories: Provide disconnect switch, duct extension with support, filter section, and washable mesh MERV- 13 filters.

2.06 UTILITY VENT BLOWERS

- A. Direct Drive Fan:
 - 1. Fan Wheel:
 - a. Type: Non-overloading, backward inclined centrifugal.
 - b. Material: Aluminum, statically and dynamically balanced.
 - 2. Housing:
 - a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
 - b. Rigid internal support structure.
 - c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
 - d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
 - e. Provide breather tube for fresh air motor cooling and wiring.
- B. Shafts and Bearings:
 - 1. Fan Shaft:
 - a. Ground and polished steel with anti-corrosive coating.
 - b. First critical speed at least 25 percent over maximum cataloged operating speed.
 - 2. Bearings:
 - a. Permanently sealed or pillow block type.
 - b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
 - c. 100 percent factory tested.
- C. Drive Assembly:
 - 1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.

2. Belts: Static free and oil resistant.
3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. Motor pulley adjustable for final system balancing.
5. Readily accessible for maintenance.
- D. Disconnect Switches:
 1. Factory mounted and wired.
 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 3. Finish for Painted Steel Enclosures: Provide manufacturer's standard or factory applied gray unless otherwise indicated.
 4. Positive electrical shutoff.
 5. Wired from fan motor to junction box installed within motor compartment.
- E. Roof Curb: 8 inch (200 mm) high; self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, curb bottom, ventilated double wall, and factory installed nailer strip.
- F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.
- G. Options/Accessories:
 1. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.
 2. Birdscreen:
 - a. Provide galvanized steel construction.
 - b. Protects fan discharge.
 3. Clean Out Port: Removable grease repellent compression rubber plug allows access for cleaning wheel through windband.
 4. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by NFPA 96.
 5. Dampers: Provide motorized type.
 6. Drain Connection:
 - a. Aluminum construction.
 - b. Allows single-point drainage of grease, water, or other residues.
 7. Finishes: Factory primed.
 8. Grease Trap:
 - a. Aluminum.
 - b. Includes drain connection.
 - c. Collects grease residue.
 9. Hinge Kit:
 - a. Aluminum hinges.
 - b. Hinges and restraint cables mounted to base (sleeve).
 - c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.
 10. Heat Baffle: Prevents heat from radiating into motor compartment.
 11. Tie-down Points: Four brackets located on windband secures fan in heavy wind applications.
 12. External motor speed controllers for field mounting.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Hung Cabinet Fans:
 1. Install fans with resilient mountings and flexible electrical leads. See Section 230548.

2. Install flexible connections specified in Section 233300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof and wall exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

3.02 SCHEDULES (TO BE COMPLETED FOR EACH PIECE OF EQUIPMENT BY CONTRACTOR)

- A. Drawing Code:
- B. Manufacturer:
- C. Model:
- D. Fan Type:
- E. Hood/Housing:
- F. Air Flow Capacity:
- G. Static Pressure:
- H. Drive:
- I. Fan Tip Speed:
- J. Fan RPM:
- K. Motor hp:
 1. Electrical Characteristics:
- L. Sound (Sones):
- M. Sound Power:

END OF SECTION

SECTION 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Diffusers:
 - 1. Perforated ceiling diffusers.
 - 2. Rectangular ceiling diffusers.
- B. Registers/grilles:
 - 1. Floor-mounted, linear supply register/grilles.
 - 2. Floor-mounted, supply register/grilles.
 - 3. Ceiling-mounted, exhaust and return register/grilles.
 - 4. Ceiling-mounted, linear exhaust and return register/grilles.
 - 5. Ceiling-mounted, supply register/grilles.
 - 6. Wall-mounted, supply register/grilles.
 - 7. Wall-mounted, exhaust and return register/grilles.
- C. Duct-mounted supply and return registers/louvers.
- D. Wall and ceiling gypsum board access panels with return air grilles.
- E. Fabric air distribution devices.
- F. Door grilles.
- G. Louvers:
 - 1. Air measuring station louvers.
 - 2. Combination louvers.
- H. Roof hoods.
- I. Goosenecks.
- J. Fire-rated enclosures.

1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- B. UL 2518 - Standard for Safety Air Dispersion Systems Current Edition, Including All Revisions.
- C. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.
- G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2020.

PART 2 PRODUCTS

2.01 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square, stamped, multi-core, square, adjustable pattern, stamped, multi-core, square and rectangular, multi-louvered, square and rectangular, adjustable pattern, multi-louvered, and N/A diffuser to discharge air in 360 degree, one way, two way, three way, four way, and N/A pattern with sectorizing baffles where indicated.
- B. Frame: Provide surface mount, snap-in, inverted T-bar, spline, and AS REQUIRED type. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Steel with baked enamel finish.
- D. Color: As selected by Architect from manufacturer's standard range.

- E. Accessories: Provide radial opposed blade, butterfly, combination splitter, and [] volume control damper; removable core, sectorizing baffle, safety chain, wire guard, equalizing grid, operating rod extension, anti-smudging device, gaskets for surface mounted diffusers, and [] with damper adjustable from diffuser face.

2.02 PERFORATED FACE CEILING DIFFUSERS

- A. Type: Perforated face with fully adjustable pattern and removable face.
- B. Frame: Surface mount type. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Stainless steel.
- D. Color: As selected by Architect from manufacturer's standard range.
- E. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.03 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS

- A. Type: Duct-mounted, rectangular register for round-spiral duct with adjustable pivot-ended blades, end caps, built-in volume damper, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.
- B. Material: 22 gauge, 0.0299 inch (0.76 mm).
 - 1. Provide crossing spiral fitting-body of matching duct diameter.

2.04 CEILING SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, one-way deflection.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- C. Construction: Made of aluminum extrusions with factory enamel finish.
- D. Construction: Made of stainless steel.
- E. Color: As selected by Architect from manufacturer's standard range.
- F. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.05 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
- C. Fabrication: Steel with 20 gauge, 0.0359 inch (0.91 mm) minimum frames and 22 gauge, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gauge, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's standard range.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
- F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.06 WALL SUPPLY REGISTERS/GRILLES

- A. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- B. Fabrication: Steel with 20 gauge, 0.0359 inch (0.91 mm) minimum frames and 22 gauge, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gauge, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
- C. Fabrication: Aluminum extrusions with factory clear lacquer finish.
- D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.07 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with spring or other device to set blades, vertical face.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's standard range.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.08 WALL AND CEILING GYPSUM BOARD ACCESS PANELS WITH RETURN AIR GRILLES

- A. Description: Return air grille with full service access. Louvers to be fitted into a frameless door that is flush with drywall surface. Return air grille can be integrated with manufacturer's suggested access panel or installed directly in drywall surface.
- B. Return Air Grille: Linear bar grilles fitted with flush and concealed perimeter grille frame.
 - 1. Type: Fixed grille with 1/4 inch (6.4 mm) thick by 5/8 inch (15.9 mm) deep bars at 1/2 inch (12.7 mm) on center providing 48 percent free area.
 - 2. Fabrication: Aluminum with factory powder coated finish.
 - 3. Frame: 1 inch (25.4 mm) margin with concealed countersunk screw mounting.
- C. Gypsum Board Access Panels: Provide rectangular access panel with recessed and gasketed aluminum perimeter frame that acts as finishing edge and having concealed mechanical touch-latch with safety cable.
 - 1. Panel Frame Size: 24 by 24 inch (610 by 610 mm) set within 1/2 inch (12.7 mm) thick gypsum board.
 - 2. Panel Frame: 1 inch (25.4 mm) margin with concealed countersunk screw mounting.

2.09 LINEAR FLOOR SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined blades with 0 degree deflection, 1/8 by 3/4 inch (3 by 19 mm) on 1/4 inch (6 mm) centers, assembled on expanded tubes mandrel construction.
- B. Frame: 1-1/4 inch (32 mm) heavy margin frame with countersunk screw mounting, and mounting frame.
- C. Fabrication: Aluminum extrusions with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's standard range.
- E. Damper: Integral gang-operated opposed blade damper with removable key operator, operable from face.

2.10 FABRIC AIR DISTRIBUTION DEVICES

- A. General Requirements:
 - 1. Diffuser material to comply with ASTM E84, UL 723, UL 2518, NFPA 90A, and NFPA 90B.

2.11 FLOOR SUPPLY REGISTERS/GRILLES

- A. Individually adjustable blades, wide stamped border, single or double blade damper with set screw adjustment.
- B. Fabricate of steel, welded construction, with factory baked enamel finish.

2.12 DOOR GRILLES

- A. Type: V-shaped louvers of 20 gauge, 0.0359 inch (0.91 mm) thick steel, 1 inch (25 mm) deep on 1/2 inch (13 mm) centers.
- B. Frame: 20 gauge, 0.0359 inch (0.91 mm) steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.13 LOUVERS

- A. Type: 4 inch (100 mm) deep frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch (13 mm) square mesh screen over intake or exhaust end.
- B. Fabrication: 16 gauge, 0.0598 inch (1.52 mm) thick galvanized steel thick galvanized steel welded assembly, with factory prime coat finish.

2.14 COMBINATION LOUVERS

- A. Damper-combined, drainable louver:
- B. Material: Extruded galvanized steel.
- C. Paint Finish and Color: As indicated on the drawings.
- D. Rust Inhibitor Coating: Standard.
- E. Sleeve or Flange: Factory-mounted standard.
- F. Linkage: Concealed in frame.
- G. Custom Features: Include architectural finish.
- H. Insulation: Water-resistant sound absorbing material.
- I. Mounting: Furnish with interior flat flange for installation.

2.15 ROOF HOODS

- A. Fabricate air inlet or exhaust hoods in accordance with SMACNA (DCS).
- B. Fabricate of galvanized steel, minimum 16 gauge, 0.0598 inch (1.52 mm) base and 20 gauge, 0.0359 inch (0.91 mm) hood, or aluminum, minimum 16 gauge, 0.0598 inch (1.52 mm) base and 18 gauge, 0.0598 inch (1.21 mm) hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch (13 mm) square mesh for exhaust and 3/4 inch (19 mm) for intake, and factory prime coat finish.
- C. Fabricate louver penthouses with mitered corners and reinforce with structural angles.
- D. Mount unit on minimum 12 inch (300 mm) high curb base with insulation between duct and curb.
- E. Make hood outlet area minimum of twice throat area.

2.16 GOOSENECKS

- A. Fabricate in accordance with of minimum 18 gauge, 0.0598 inch (1.21 mm) galvanized steel.
- B. Mount on minimum 12 inch (300 mm) high curb base where size exceeds 9 by 9 inch (230 by 230 mm).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 099123.

END OF SECTION

SECTION 233600
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single-duct bypass air units.
- B. Single-duct terminal units.
 - 1. Single-duct, constant-volume units.
 - 2. Single-duct, variable-volume units.

1.02 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 230993 - Sequence of Operations for HVAC Controls.
- C. Section 233100 - HVAC Ducts and Casings.
- D. Section 251400 - Integrated Automation Local Control Units: HVAC controllers.
- E. Section 253513 - Integrated Automation Actuators and Operators: Actuators.
- F. Section 253516 - Integrated Automation Sensors and Transmitters: Thermostats.

1.03 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils 2001, with Addenda (2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals 2017.
- C. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units 2016.
- D. ASTM A492 - Standard Specification for Stainless Steel Rope Wire 1995 (Reapproved 2019).
- E. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope 2019.
- F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) 2019.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- I. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems 2008.
- J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
- K. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
 - 1. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 to 4 inch wg (250 to 1000 Pa).
- D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- E. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- F. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.

- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for air terminal units.

PART 2 PRODUCTS

2.01 SINGLE-DUCT BYPASS UNITS

- A. General:
 - 1. Factory-assembled, variable air volume control bypass units, rated in accordance with AHRI 880 (I-P).
 - 2. Clearly label each unit indicating maximum/minimum cfm, tag/mark number, model number, and manufacturer's order number.
- B. Construction:
 - 1. Casing: Minimum 22 gauge, 0.0299 inch (0.76 mm) galvanized steel, acoustically and thermally lined with minimum 0.50 inch (13 mm), dual-density insulation, meeting the requirements of NFPA 90A, UL 181, and ASTM C1071.
 - 2. Air volume control assemblies to consist of galvanized steel damper, steel, cylindrical flow diverter valve, or sliding gate valve.
 - 3. Acceptable air balancing assemblies include field adjustable, inlet and bypass dampers with static pressure taps for field balancing, sliding balancing door, or MANUFACTURERS STANDARD.
- C. Electrical Requirements:
 - 1. Single-point power connection.
 - 2. Equipment wiring to comply with requirements of NFPA 70.
- D. Controls:
 - 1. Electronic:
 - a. Wall-mounted thermostat, with integral control of room temperature, time-proportional with reheat-coil control feature and temperature set-point display in Celsius and Fahrenheit.
 - b. Damper Actuator: 24 volt, powered open/closed.
 - c. See Sections 25 1400, 25 3513, and 25 3516.
 - 2. Control Sequence: See Section 230993.

2.02 SINGLE-DUCT, VARIABLE-VOLUME AND CONSTANT-VOLUME UNITS

- A. General:
 - 1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
 - 2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
- B. Unit Casing:
 - 1. Minimum 22 gauge, 0.0299 inch (0.76 mm) galvanized steel.
 - a. Casing leakage to meet ASHRAE Std 130.
 - 2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
 - 3. Unit Discharge: Rectangular, with slip-and-drive connections.
 - 4. Acceptable Liners:
 - a. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- C. Sound Attenuator:
 - 1. Provide if required to meet scheduled acoustical performance requirements.

2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
 3. At 2000 fpm (10.16 m/s) inlet velocity, the minimum operating pressure with attenuator added not to exceed 0.14 inch wg (34.84 Pa).
- D. Damper Assembly:
1. Heavy-gauge, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
 2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
 3. Incorporate low leak damper blades for tight airflow shutoff.
- E. Controls:
1. Electronic:
 - a. Damper Actuator: 24 volt, power closed, spring return open.
 - b. Velocity Controller:
 - 1) Settings for minimum/maximum air volumes, factory-calibrated, and field adjustable at thermostat.
 - 2) Maintain constant airflow dictated by thermostat to within 5 percent of set point while compensating for inlet static-pressure variations up to 4 inch wg (1 kPa), when tested in accordance with ASHRAE Std 130.
 - 3) Provide controller with multi-point with velocity sensors located in air inlets and outlet.
 - c. Thermostat: Wall-mounted, time-proportional with reheat-coil control including a temperature set-point display in Celsius and Fahrenheit.
 - d. See Sections 25 1400, 25 3513, and 25 3516.
 2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
 - a. Signal accuracy: Plus/minus five percent throughout terminal operating range.
 3. Control Sequence:
 - a. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg (60 and 750 Pa) inlet static pressure.
 - b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.
 - c. See Section 230993.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
- E. Do not support from ductwork.
- F. Connect to ductwork in accordance with Section 233100.

3.02 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

3.03 CLEANING

- A. Vacuum clean coils and inside of units.
- B. Install new filters.

END OF SECTION

SECTION 234000
HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Activated carbon filters.
- B. Automatic renewable media filters.
- C. Disposable, extended area panel filters.
- D. Disposable panel filters.
- E. Extended surface high efficiency media filters.
- F. Extended surface non-supported media filters.
- G. Extended surface retained media filters.
- H. High efficiency particulate air (HEPA) filters.
- I. Washable permanent panel filters.
- J. Filter frames and housings.
- K. Filter gauges.
- L. Electronic air cleaners.
- M. Ultraviolet lights.

1.02 REFERENCE STANDARDS

- A. ACGIH - Ultraviolet Radiation, TLV Physical Agents 2010, 7th edition.
- B. AHRI 850 (I-P) - Performance Rating of Commercial and Industrial Air Filter Equipment 2013.
- C. AHRI 851 (SI) - Performance Rating of Commercial and Industrial Air Filter Equipment 2013.
- D. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Errata (2020).
- E. UL 153 - Portable Electric Luminaries Current Edition, Including All Revisions.
- F. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
- G. UL 586 - High Efficiency, Particulate, Air Filter Units Current Edition, Including All Revisions.
- H. UL 867 - Electrostatic Air Cleaners Current Edition, Including All Revisions.
- I. UL 900 - Standard for Air Filter Units Current Edition, Including All Revisions.
- J. UL 1598 - Luminaires Current Edition, Including All Revisions.
- K. UL 1995 - Heating and Cooling Equipment Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.
- C. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One set of each type and size.

PART 2 PRODUCTS

2.01 ACTIVATED CARBON FILTERS

- A. Assembly: Galvanized steel unit incorporating extruded aluminum tracks to accommodate filter servicing trays in deep V arrangement arranged for upstream servicing with disposable panel pre-filter.
 - 1. Nominal Size: 12 by 24 by 29 inches (305 by 610 by 735 mm).

- B. Media:
 - 1. Activated Carbon Density: 34 lb/cu ft (550 kg/cu m), pelletized or granular to 6 by 10 Tyler mesh screen.
 - 2. Carbon Tetrachloride Activity: Minimum 60 percent; in thin bed.
 - 3. Trays: Nominal size 24 by 24 by 5/8 inches (610 by 610 by 16 mm) thick.
 - 4. Carbon: 1.42 cu ft per 1000 CFM (22 kg per 470 L/sec) nominal air flow capacity.
- C. Rating: 500 FPM (2.54 m/sec) face velocity, 0.45 inch WG (110 Pa) resistance.

2.02 AUTOMATIC RENEWABLE MEDIA FILTERS

- A. Assembly: Galvanized steel assembly, with drive, controls, and media, that feeds media across air stream and winds and compresses used media for disposal. Enclose the clean media roll with hinged roll cover. Include tension panel to compress used media as it is spooled. Arrange to allow upstream replacement of filter media.
- B. Media: UL 900 Class 2, rolled and compressed, graduated density glass fiber blanket, nominally 2 inch (50 mm) thick when expanded, 50 feet (15 m) long; factory sprayed with flameproof, non-drip, non-volatile adhesive; bonded reinforcing on leaving side of media to prevent stretching and necking.
- C. Performance Rating, ASHRAE Std 52.2:
 - 1. Weight Arrestance: Minimum 80 percent.
 - 2. Face Velocity: 500 FPM (2.54 m/sec).
 - 3. Initial Resistance at Pressure: 0.17 inch WG (40 Pa).
 - 4. Recommended Final Resistance: 0.50 inch WG (125 Pa).
- D. Controls: Provide manual switch to advance media.
- E. Frame: Auxiliary frame on downstream side of unit for downstream access to extended surface retained media filters.

2.03 DISPOSABLE, EXTENDED AREA PANEL FILTERS

- A. Media: UL 900 Class 1, pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid by corrugated aluminum separators.
 - 1. Frame: Non-flammable.
 - 2. Nominal size: 12 by 24 inches (305 by 610 mm).
 - 3. Nominal thickness: 1 inch (25 mm).
- B. Minimum Efficiency Reporting Value (MERV): 8, when tested in accordance with ASHRAE Std 52.2.
- C. Rating, per ASHRAE Std 52.2:
 - 1. Weight arrestance: 85 percent.
 - 2. Initial resistance at 500 FPM (2.54 m/sec) face velocity: 0.20 inch WG (50 Pa).
 - 3. Recommended final resistance: 0.9 inch WG (224 Pa).

2.04 DISPOSABLE PANEL FILTERS

- A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
 - 1. Thickness: 1 inch (25 mm).
- B. Performance Rating:
 - 1. Initial Resistance: 0.15 inch WG (37 Pa).
 - 2. Recommended Final Resistance: 0.50 inches WG (125 Pa).
- C. Casing: Cardboard frame.

2.05 EXTENDED SURFACE HIGH EFFICIENCY MEDIA FILTERS

- A. Media: Pleated, water-resistant glass fiber with aluminum separators; in 16 gauge, 0.0598 inch (1.52 mm) steel holding frame with corrosion resistant coating.
 - 1. Nominal Size: 24 by 24 by 6 inches (610 by 610 by 150 mm) deep.
- B. Minimum Efficiency Reporting Value (MERV): 15, when tested in accordance with ASHRAE Std 52.2.
- C. Performance Rating, per ASHRAE Std 52.2:
 - 1. MIL-STD-282 Test 0.3 Micron Dioctyl Phthalate Smoke (DOP) Efficiency: 99 percent.
 - 2. Initial Resistance at 150 fpm (0.63 m per sec) Face Velocity: 0.35 inch WG (87 Pa).

3. Recommended Final Resistance: 1.5 inch WG (375 Pa).

2.06 EXTENDED SURFACE NON-SUPPORTED MEDIA FILTERS

- A. Media: UL 900 Class 1 reinforced glass fiber preformed into series of pockets with media spacing controls by variable length stitches; galvanized steel header frame.
 1. Media Area: 35 sq ft of media per 1000 CFM (6.9 sq m per 1000 L/sec) capacity.
 2. Nominal size: 24 by 24 inches (610 by 610 mm) face, 22 inches (560 mm) deep.
- B. Minimum Efficiency Reporting Value (MERV): 13, when tested in accordance with ASHRAE Std 52.2.
- C. Performance Rating, per ASHRAE Std 52.2:
 1. Percent Weight Arrestance: 97.
 2. Initial Resistance: 0.30 inch WG (75 Pa).
 3. Recommended Final Resistance: 1.0 inch WG (250 Pa).

2.07 EXTENDED SURFACE RETAINED MEDIA FILTERS

- A. Media: Class 1 pleated, non-woven cotton fabric, scrim reinforced; supported by welded steel retainer; in 16 gauge, 0.0598 inch (1.52 mm) steel holding frame with corrosion resistant coating.
 1. Effective Media Area: 16 sq ft per 1000 CFM (3.1 sq m per 1000 L/sec) capacity rating.
 2. Nominal Size: 24 by 24 by 12 inches (610 by 610 by 300 mm) deep.
- B. Minimum Efficiency Reporting Value (MERV): 13, when tested in accordance with ASHRAE Std 52.2.
- C. Performance Rating: ASHRAE Std 52.2;
 1. Percent Average Weight Arrestance: 92.
 2. Initial Resistance at 500 FPM (2.54 m/sec) Face Velocity: 0.20 inch WG (50 Pa).
 3. Recommended Final Resistance: 0.50 inch WG (125 Pa) above initial resistance.

2.08 HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS

- A. Media: UL 586, pleated, water-resistant glass fiber with separators of aluminum:
 1. Holding Frame: Plywood.
 2. Media to Frame Side Bond: Polyurethane foam.
 3. Face Gasket: Neoprene expanded rubber.
 4. Nominal Size: 24 by 24 by 12 inches (610 by 610 by 300 mm) deep.
- B. Minimum Efficiency Reporting Value (MERV): 15, when tested in accordance with ASHRAE Std 52.2.
- C. Performance Rating:
 1. MIL-STD-282 Test 0.3 Micron Dioctyl Phthalate Smoke (DOP) Efficiency: 99.97 percent.
 2. Rated Air Flow Capacity at 1.0 inch WG (250 Pa): 1150 CFM (540 L per sec).
 3. Recommended Final Resistance: 3.0 inch WG (750 Pa).

2.09 WASHABLE PERMANENT PANEL FILTERS

- A. Media: 14 mesh steel screen, zinc electroplated, alternate layers of flat and herringbone crimp, four layers per inch (25 mm); rod reinforced.
 1. Frame: 16 gauge, 0.0598 inch (1.52 mm) galvanized steel.
- B. Performance Rating:
 1. Recommended Final Resistance at 500 FPM (2.54 m/sec) face velocity: 0.50 inch WG (125 Pa).

2.10 FILTER FRAMES AND HOUSINGS

- A. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for 24 by 24 inches (610 by 610 mm) filter media, minimum 2 inches (50 mm) thick; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.
- B. Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 16 gauge, 0.0598 inch (1.52 mm) galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary secondary filters with positive sealing gaskets.

2.11 FILTER GAUGES

- A. Direct Reading Dial: 3-1/2 inch (90 mm) diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-0.5 inch WG (0-125 Pa), 2 percent of full scale accuracy.
- B. Inclined Manometer: One piece molded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0-3 inch WG (0-750 Pa), 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch (6 mm) aluminum tubing, 2-way or 3-way vent valves.

2.12 ELECTRONIC AIR CLEANERS

- A. Assembly: UL 867; galvanized steel assembly containing electronic agglomerate and disposable panel filters.
- B. Electronic Agglomerator: Independently supported and nested collection cells of aluminum construction including ionizing section consisting of alternately spaced grounded struts and charged ionizing wires, and collecting section consisting of alternately grounded and charged plates, with insulators located out of air stream.
- C. Power Pack: Self-contained, pre-wired rectifying unit to convert 120 volts, single phase, 60 Hz AC power to approximately 12,000 volts DC for ionizer and 6,000 volts DC for collector, including overload protection, on-off switch, pilot light indicating operating status.
- D. Safety Accessories: Manual reset safety switches and warning lights for filter plenum access doors, signal lights and safety switching upstream and downstream of unit within duct, and enameled high voltage warning signs.

2.13 ULTRAVIOLET LIGHTS

- A. Tested and recognized by UL 153, UL 1598 and UL 1995 for luminaries, heating, and cooling equipment.
- B. UV-C Short Wave Light Array Performance: Provide not less than 190 microwatts/sq in (1225 microwatts/sq cm).
- C. Factory assemble and test UV-C fixtures in the air handling unit.
- D. Materials:
 - 1. Provide UV-C resistant polymeric materials or shield from direct or indirect UV-C light with UV-C tolerant material.
 - 2. UV-C Fixtures: Stainless steel to resist corrosion.
- E. Lamp Life: 9000 hours minimum with no more than 20 percent loss of output after two years of continuous use.
- F. Mount UV-C fixtures on slide-out rack to enable servicing from unit exterior via access door.
- G. View Port: Provide with cover to allow viewing of the UV-C light array.
- H. Control Panel: Provide a control panel for each UV-C light array.
 - 1. Comply with UL 508A.
 - 2. Components to be marked with the minimum SCCR (Short Circuit Current Rating).
 - 3. Provide enclosure with NEMA 4X rating for prevention of corrosion and water ingress.
 - 4. Provide control panel with current sensor to indicate status of the UV-C array.
- I. Safety Features:
 - 1. Treat view port and other windows to assure the UV-C energy emitted is below the threshold limit specified by American Conference of Governmental Industrial Hygienists (ACGIH).
 - 2. Provide a mechanical interlock switch to disconnect power to the UV-C fixtures when the opening of an access door may pose an exposure risk to UV-C light.
 - 3. Provide externally mounted, on-off, disconnect, and shutoff switch with lockout/tagout that disconnects UV-C power and prevents unwanted operation of UV-C lights.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

- C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.
- E. Provide filter gauges on filter banks, installed with separate static pressure tips upstream and downstream of filters.
- F. UV-C system to be commissioned by manufacturer field representative.

3.02 SCHEDULES (TO BE FILLED OUT BY CONTRACTOR FOR EACH PIECE OF EQUIPMENT AND PROVIDED TO EOR TO BE ADDED TO FINAL AS-BUILT DRAWINGS)

- A. Air Filter Schedule:
- B. Drawing Code:
- C. Location:
- D. Type:
- E. Number:
- F. Size:
- G. Air Flow:
- H. Face Velocity:
- I. Overall Height:
- J. Overall Width:
- K. Initial Resistance:
- L. Final Resistance:

END OF SECTION

SECTION 237223
PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Energy recovery units.
- B. Casing.
- C. Fans.
- D. Total energy wheel.
- E. Filters.
- F. Dampers.
- G. Vibration isolation.
- H. Roof curbs.
- I. Power and controls.
- J. Accessories.
- K. Service accessories.

1.02 RELATED REQUIREMENTS

- A. Section 077200 - Roof Accessories: Roof curb.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2015.
- C. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment 2018.
- D. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Errata (2020).
- E. ASHRAE Std 84 - Method of Testing Air-to-Air Heat/Energy Exchangers 2020, with Errata (2021).
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- G. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings 2019.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- L. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's installation instruction, product data, and engineering calculations.
- C. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.
- D. Manufacturer's Qualification Statement.

- E. Closeout Submittals: Submit manufacturer's operation and maintenance instructions.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Warranty ventilator to be free from defects in material and workmanship and of all parts for period of 1-1/2 years from date of Substantial Completion.
- C. Warranty energy recovery wheel to be free from defects in material and workmanship for 3 years under circumstances of normal use.
- D. Warranty motor to be free from defects in material and workmanship for 7 years under circumstances of normal use.
- E. Warranty desiccant core to be free from defects in material and workmanship for 5 years under circumstances of normal use.

PART 2 PRODUCTS

2.01 ENERGY RECOVERY DESIGN CRITERIA (SEE DRAWINGS AND USE CONDITIONS LISTED. DO NOT ALTER CONDITIONS WITHOUT PRIOR APPROVAL FROM ENGINEER OF RECORD AGE)

- A. Summer Conditions:
 - 1. Outside Air:
 - a. Dry Bulb: [] degrees F ([] degrees C).
 - b. Wet Bulb: [] degrees F ([] degrees C).
 - 2. Return Air:
 - a. Dry Bulb: [] degrees F ([] degrees C).
 - b. Wet Bulb: [] degrees F ([] degrees C).
- B. Winter Conditions:
 - 1. Outside Air:
 - a. Dry Bulb: [] degrees F ([] degrees C).
 - b. Percent Relative Humidity: [] percent.
 - 2. Return Air:
 - a. Dry Bulb: [] degrees F ([] degrees C).
 - b. Percent Relative Humidity: [] percent.
- C. Power Supply Electrical Characteristics:
 - 1. Volts: 208.
 - 2. Phase: 3.

2.02 APPLICATIONS

2.03 ENERGY RECOVERY UNITS

- A. Energy Recovery Units: Provide desiccant wheel type or stationary core air-to-air exchanger; prefabricated packaged system designed by manufacturer.
 - 1. Provide unit with a AHRI 1060 (I-P) compliant air-to-air exchanger.
 - 2. Access: Hinged and/or screwed access panels on front.
 - 3. Lifting holes at the unit base.
 - 4. Framing: Welded extruded aluminum tubular frame capable of supporting components and casings.
 - 5. Permanent name plate listing manufacturer mounted inside door near electrical panel.
- B. Accessories:
 - 1. Make-up Air Damper: Normally closed damper to replace exhausted air.
 - a. Duct Construction: Galvanized steel.
 - b. Duct Connections: 6 inch (150 mm) diameter.
 - c. Provide with pressure switch and electric actuator.
 - d. Electrical Requirements:

- 1) 24-volt transformer.
- 2) Equipment wiring to comply with requirements of NFPA 70.

2.04 CASING

- A. Wall, Floor, and Roof Panels:
1. Panels: Removable.
 2. Construction: 1 inch (25 mm) thick, double wall box construction, with formed edges of exterior wall overlapping formed edges of interior wall.
 3. Aluminum is standard. Factory-painted aluminized steel is an economic alternative when the higher corrosion resistance of aluminum is not required.
 4. Exterior Wall: Galvanized steel sheet.
 - a. 20 gauge, 0.0359 inch (0.91 mm) galvanized steel.
 - b. 0.040 inches (1 mm) thick aluminum.
 - c. Color: Gray.
 5. Interior Wall: Galvanized sheet metal.
 - a. 20 gauge, 0.0359 inch (0.91 mm) aluminized steel.
 - b. 22 gauge, 0.0299 inch (0.76 mm) galvanized sheet metal.
 6. Insulation:
 - a. 1/2 inch (13 mm) insulated fiberglass.
 - b. Panel Cores: Mineral wool board.
 - c. Include antimicrobial protection.
 - d. Mold Resistance: "Pass" when tested according to ASTM C1338.
 - e. Fungal Resistance: No growth when tested according to ASTM G21.
 - f. Bacteria Resistance: No growth when tested according to UL 181.
 - g. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
 - h. Smoke Developed Index (SDI): 50, maximum, when tested in accordance with ASTM E84 or UL 723.
 - i. Secure insulation to unit with waterproof adhesive and permanent mechanical fasteners.
 7. Roof Panel: Weatherproof.
 8. Panel Joints: T-shaped standing seams with overlapping metal caps.
 9. Fasteners: Stainless steel.
 10. Isolation and Seal: Form continuous, thermally isolated, weather tight seal between inner wall of panels and structural framing with closed cell PVC foam gasketing.
 11. Seams: Sealed, requiring no caulking at job site.
 12. Coating: Polyurethane enamel.
- B. Access Panels: Provide access to components through a large, tightly sealed and easily removable panel.
- C. Doors:
1. Construct doors of same construction and thickness as wall panels.
 2. Height: 80 inches (2032 mm).
 3. Hardware:
 - a. Hinges: Aluminum.
 - b. Corrosion-resistant.
 - c. Provide exterior handle and interior 3-point latching device.
 - d. Prop Rod: Capable of propping doors in open position.
 - e. Wind Restraint: Door chain with spring to absorb force of door swinging open.
 - f. Gasket: P-shaped extruded neoprene.
 - g. Label each door to identify equipment located within.
- D. Trim: 0.08 inches (2 mm) aluminum, continuously welded.
- E. Install panels on structural framing with self-tapping stainless steel screws with integral neoprene-backed stainless steel washers.
- F. Duct Connection Collars: 0.08 inches (2 mm) aluminum, continuously welded.
- G. Weather Hood: Provide on fresh air inlet and exhaust air outlet; removable for access.
1. Construction: ASTM A653/A653M, G90/Z275 galvanized, 20 gauge, 0.0359 inch (0.91 mm) steel sheet.

2. Screening: Expanded aluminum bird screen.
3. Fresh Air Weather Hood: Maintain a face velocity less than 340 feet/min (1.6 m/s).

2.05 FANS

- A. Provide separate fans for exhaust and supply blowers.
- B. Fans:
 1. Individually driven with a dedicated motor.
 2. Backward inclined.
 3. Single width, single inlet.
 4. Class 1 aluminum wheels.
 5. AMCA-rated.
 6. Provide with non-overloading characteristics.
 7. Provide non-sparking integral spun steel venturie inlet cones.
- C. Bearings:
 1. Pillow block.
 2. Bearings: Permanently lubricated sealed ball bearings.
 3. Rated for not less than 200,000 hours of operation with accessible greased fittings.
- D. Housings: 12 gauge, 0.1046 inch (2.66 mm) aluminized steel with plenums integral to general housing and constructed to Class 1 fan standards.
- E. Motors:
 1. Motors: Open drip proof.
 2. Efficiency: High.
 3. Speed: Single.
 4. Control: Constant Speed.
 5. Fan Motor: UL listed and labeled.
- F. Drives:
 1. Fans: Belt driven.
 2. Horsepower: 7.5 HP (5.2 kW).
 3. Service Factor: 1.2.

2.06 TOTAL ENERGY WHEEL

- A. Wheel: Transfer heat and humidity from one air stream to the other with minimum carryover of the exhaust air into the supply air stream.
- B. Energy Wheel Media: Cleanable with low temperature steam, hot water or light detergent, without degrading the latent recovery.
- C. Sensible Recovery Efficiency: 73.
- D. Latent Recovery Efficiency: 63.
- E. Wheel Effectiveness: Rated in accordance with ASHRAE Std 84 and AHRI 1060 (I-P).
- F. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
- G. Smoke Developed Index (SDI): 50 or less, when tested in accordance with ASTM E84 or UL 723.
- H. Energy Recovery Wheel Media Face:
 1. Comply with NFPA 90A.
 2. Coating: Acid resistant coating.
- I. Coat all corrugated surfaces with a thin non-migrating absorbent layer.
- J. Rotor:
 1. Type: Non-segmented hygroscopic aluminum wheel.
 2. Rotor Matrix: Corrosion resistant aluminum alloy composed of alternating corrugated and flat, continuously wound layers of uniform widths.
 3. Depth: 8 inches (203 mm).

4. Rotor Wheel: Reinforce with spokes, welded at the hub and perimeter to prevent any uneven run out during normal operations.
- K. Desiccant:
 1. Type: 3A.
 2. Performance:
 - a. Desiccant: Non-dissolving, permanent, and resistant to damage from compressed air, low temperature steam, hot water or by vacuum cleaning.
 3. Ventilation Factor: 1.00.
- L. Pneumatic Seals: Extruded adjustable brush seals.
 1. Locations:
 - a. Around perimeter of wheel, and mounted perpendicular to face of wheel.
 - b. Separation between exhaust and supply air streams on both sides of wheel.
 2. Pressure Differential: Adjustable by means of a lockable quadrant operator.
- M. Drive:
 1. Drive: Tensioned drive with full perimeter link style belt.
 2. Inertial Shock Absorber: Absorb start and stop inertial shock to gear reducer.
 3. Select above or below depending on type of motor required.
- N. Purge Angle:
 1. Purge Angle: Field adjustable from zero to six degrees of rotor circumference arc to suit the prevailing pressure conditions.
 2. Divert sufficient supply air to accomplish full purging of exhaust-air from energy wheel to achieve no cross contamination.
- O. Wheel Rotation Detection:
 1. Turn off energy recovery unit if improper rotor rotation is detected.
 2. Send alarm to Building Management System if rotation is not detected or belt is slipping.
 3. Retain the following when calculations indicate frost could form on energy wheel. Note that frost control is not required when using variable frequency drive motors on wheel.

2.07 FILTERS

- A. Efficiency: 13 MERV.
- B. Exhaust and Fresh Air Streams: MERV 7 filters constructed to meet ASHRAE Std 52.2.
- C. Filter Racks: Bolt-on rack constructed of 0.08 inches (2 mm), minimum, thick aluminum with hinged side access door and snap fasteners.
- D. Pre-Filter: 30-30 pleated filters, 2 inches (50 mm) thick on outside air inlet.
- E. Filter Removal Hooks: Provide means to remove filters that are not immediately accessible from exterior of unit
- F. Mount 1/2 inches (13 mm) thick permanent aluminum washable type filter in the outside air hood and in the return plenum air.
- G. Provide spare set of filters.

2.08 DAMPERS

- A. Exhaust Back-Draft Damper: Factory installed, galvanized steel.
 1. High performance, backdraft dampers suitable for application in HVAC systems with velocities to 3000 feet per minute (914 m/min).
 2. Louvers, Dampers, and Shutters: AMCA 500-D and AMCA 500-L.
 3. Damper Capacity: Demonstrate damper capacity to withstand HVAC system operating conditions.
 - a. Closed position: 6 inches w.g. (1.5 kPa).
 - b. Open position: 3000 feet per minute (914 m/min).
 4. Fabrication:
 - a. Frame: 20 gauge, 0.0359 inch (0.91 mm), 3 inch (76 mm) roll formed galvanized steel channel with rear flange, prepunched mounting holes, and welded corner clips for maximum rigidity.
 - b. Blades:

- 1) Style: Single-piece, overlap frame.
 - 2) Material: Roll formed 28 gauge, 0.0149 inch (0.38 mm) galvanized steel.
 - 3) Width: Maximum 6 inches (152 mm).
 - c. Blade Seals: Extruded vinyl, mechanically attached to the blades edge.
 - d. Linkage: Galvanized steel tie bar with stainless steel pivot pins mounted on blades.
 - e. Axles: Stainless steel.
 - f. Mounting: Vertical.
 - g. Finish: Mill galvanized.
- B. Return Air Damper:
1. Factory installed, adjustable volume control, opposed blade damper for regulating airflow, based on external static pressure.
 2. Conceal linkage out of air stream, within damper frame to reduce pressure drop and noise and lessen need for maintenance.
 3. Form from single piece of minimum 16 gauge, 0.0598 inch (1.52 mm) galvanized steel.
 4. Return Air Damper: Structural hat channels, reinforced at corners.
 5. Roll-formed Frames: Structurally superior to 13 gauge, 0.0897 inch (2.28 mm) U-channel frames.
 6. Blades: Single skin, 16 gauge, 0.0598 inch (1.52 mm).
 7. Bearings: Corrosion resistant, molded synthetic sleeve type turning in extruded hole in damper frame.
- C. Return Air Inlets: Provide expanded metal grating in welded frame to prevent items larger than 1/2 inch (13 mm) in diameter from falling into ducts below.
- D. Motorized Dampers: Provide motorized dampers at outside air inlet, exhaust air outlet, and supply air outlet.
1. Type: Motorized two position parallel blade damper with blade seals.
 2. Motorized Damper: Roll-formed structural hat channels, reinforced at the corners,
 3. Formed from single piece of minimum 16 gauge, 0.0598 inch (1.52 mm) galvanized steel.
 4. Blades: Single skin, 16 gauge, 0.0598 inch (1.52 mm).
 5. Blade Edge Seals: PVC coated polyester fabric suitable for minus 25 degrees F (32 degrees C) to 180 degrees F (83 degrees C).
 6. Jamb Seals: Flexible stainless, compression type to prevent leakage between end of the blade and the damper frame.
 7. Bearings: Corrosion resistant, molded synthetic sleeve type turning in extruded hole in damper frame.
 8. Conceal linkage out of air stream, within damper frame to reduce pressure drop and noise and lessen need for maintenance.
- E. Motorized Louvers:
1. Type: Motorized two position parallel blade louver with drainable blades, blade seals, and jamb seals
 2. Locations: Provide at outside air inlet.
 3. Adjustable louver:
 - a. Fabrication: Mullion style.
 - 1) Frame:
 - (a) Depth: 4 inches (102 mm).
 - (b) Material: Extruded aluminum, Alloy 6063-T5.
 - 2) Blades:
 - (a) Style: Horizontal, adjustable, drainable.
 - (b) Material: Formed aluminum, Alloy 6063-T5.
 - (c) Thickness: 0.081 inches (2.1 mm).
 - (d) Angle: 45 degrees .
 - (e) Centers: 5 inches (127 mm).
 - (f) Linkage: Concealed in frame.
 - (g) Bearings: Stainless steel sleeve pressed into frame.
 - (h) Axles: 1/2 inches (13 mm) plated steel hex.
 - (i) Provide blade and jamb seals.
 - 3) Gutters: Drain gutter in head frame and each blade.

- 4) Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.

2.09 VIBRATION ISOLATION

- A. Vibration Isolation: Provide whole unit vibration isolation with the energy recovery unit assembly.
- B. Construct with appropriately-sized, seismic-rated, corrosion-resistant captive-spring isolators.

2.10 ROOF CURBS

- A. Curbs: Provide full perimeter roof curb fabricated from 10 gauge, 0.1345 inch (3.42 mm) aluminized steel.
 1. Curbs: Knock-down type.
 2. Provide flat for roof deck.
- B. Isolation Rails: Provide factory-installed, 12 gauge, 0.1046 (2.66 mm) aluminized steel angles top and bottom, connected with flexible, outdoor rated membrane and factory-installed vibration isolation springs.
- C. Gaskets: Provide closed cell PVC foam.
 1. Install between top flange of isolation rail and bottom of energy recovery unit.
 2. Install on top of curb.

2.11 POWER AND CONTROLS

- A. Motor Control Panels: UL listed.
- B. Include necessary motor starters, fuses, transformers and overload protection according to NFPA 70.
- C. Provide single-point field connection to power supply.
- D. Provide non fused main disconnect integral to control panel.
- E. Install wiring in accordance with NFPA 70.
- F. Wiring: Enclosed in flexible, liquid tight steel conduit.

2.12 ACCESSORIES

- A. Airflow Monitor:
 1. Include integral airflow monitoring station with ability to read both ventilation and exhaust airflow expressed in cfm (L per min).
 2. Mount monitor gauge on unit exterior and make casing connection watertight.
- B. Rotation Detector:
 1. Equip unit with rotation sensor.
 2. Equip controller with outdoor air temperature sensor that stops energy recovery wheel during moderate temperature periods.
 3. Alarm Contact: 24 volt AC signal suitable for operating a relay.
 4. Provide periodic stop function long enough to promote self-cleaning of wheel but not long enough to induce energy recovery.
 5. Allow the energy recovery wheel to be operated in stop mode during very low temperature periods to prevent freezing of wheel while still delivering outdoor air through the unit.
- C. Remote Indicating Panel: Provide remote indication of status of unit power on, wheel rotation alarm, outside air dirty filter and return air dirty filter.
- D. Electric Preheat Coil:
 1. Resistance coil type with elements enclosed in a steel sheath with fins and painted with a baked-on aluminum paint for long life in a 100 percent outdoor air stream.
 2. Coil: UL listed and constructed in accordance with NFPA 70 requirements.
- E. Freeze Protection Thermostat:
 1. Equip unit with thermostat such that unit can be stopped when temperature drops to 23 degrees F (minus 5 degrees C).

2.13 SERVICE ACCESSORIES

- A. Internal Service Lights: Provide vapor tight light with protective cage and minimum 40 watt bulb.

- B. Electrical Receptacle:
 - 1. Provide duplex, ground fault interrupter type receptacle.
 - 2. Provide re-settable circuit breaker in control panel.
- C. Switch: 2 type.
 - 1. Two Position Type: Service and operate.
 - 2. Three Position Type: Low, Standby, and Medium.
- D. Electrical Components: Factory wired for single point power connection.
 - 1. 60 Hz power connection.
 - 2. Isolate electrical box from the airflow.
 - 3. Protect all integral wires and connections.
 - 4. Electrical Components: UL Listed.
 - 5. Electrical Panel: NEMA 3R mounted on the unit exterior for ease of access.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that structure is ready for installation of unit, that openings in deck for ductwork, if required, are correctly sized and located, and that mechanical and electrical utilities supplying unit are of correct capacities and are accessible.

3.02 INSTALLATION

- A. Provide openings for suitable ductwork connection.
- B. Outdoor Installations:
 - 1. Roof Panels:
 - a. Fasteners: Use concealed means of attachment.
 - b. Minimize penetrations through roof.
 - c. Provide weather tight seal at required penetrations.
 - 2. Provide drip edge around roof perimeter.
 - 3. Do not locate roof panel joints above doors.

3.03 SYSTEM STARTUP

- A. Provide services of manufacturer's authorized representative to provide start up of unit.

3.04 CLEANING

- A. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.
- B. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

END OF SECTION

SECTION 237413
PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged roof top unit.
- B. Unit controls.
- C. Remote panel.
- D. Roof mounting curb and base.
- E. Maintenance service.

1.02 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 253519 - Integrated Automation Control Valves.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment 2015, with Addendum.
- C. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks 2020, with Errata and Amendments (2022).
- D. Bluetooth CS - Bluetooth Core Specification 2016, Addendum 2017.
- E. Modbus (PS) - The Modbus Organization Communications Protocol. Latest Update.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- D. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- E. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide a five year warranty to include coverage for refrigeration compressors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carrier Corporation; [____]: www.carrier.com/#sle.
- B. Trane Technologies, PLC; [____]: www.trane.com/#sle.

- C. York, a brand of Johnson Controls International, PLC; [____]: www.johnsoncontrols.com/#sle.
- D. PRE-APPROVED EQUAL MAY BE SUBMITTED TO ENGINEER OF RECORD.

2.02 PERFORMANCE REQUIREMENTS (SEE MECHANICAL SCHEDULE FOR EXACT REQUIREMENTS)

- A. Heat Pump Heating:
- B. Cooling Capacity:
- C. Supply Air:
- D. Return Air:

2.03 FABRICATION

- A. Cabinet: Steel with baked enamel finish, including access panels with screwdriver operated flush cam type fasteners. Structural members shall be minimum 18 gauge, 0.0478 inch (1.21 mm), with access doors or panels of minimum 20 gauge, 0.0359 inch (0.91 mm).
- B. Supply and Return Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch pulley, and rubber isolated hinge mounted high efficiency motor or direct drive; see Section 230548. Isolate complete fan assembly.
- C. Air Filters:
 - 1. 2 inch (50 mm) thick glass fiber disposable media in metal frames.
- D. Roof Mounting Curb: 24 inches (610 mm) high galvanized steel, channel frame with gaskets, nailer strips.
- E. Vibration Isolation Curb: AS REQUIRED.

2.04 ELECTRIC HEATING COIL

- A. Finned tube heating elements easily accessible with automatic reset thermal cut-out, built-in magnetic contactors, galvanized steel frame, control circuit transformer and fuse, manual reset thermal cut-out, airflow proving device, toggle switch (pilot duty), load fuses.
- B. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

2.05 COMPRESSOR

- A. Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.
- B. Five minute timed off circuit to delay compressor start.
- C. Outdoor thermostat to energize compressor above 35 degrees F (2 degrees C) ambient.
- D. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control utilizing thermistors.

2.06 MIXED AIR CASING

- A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper to fall to closed position. Relief dampers may be gravity balanced.
- B. Gaskets: Provide tight fitting dampers with edge gaskets maximum leakage 5 percent at 2 in-wc (500 Pa) pressure differential.

2.07 OPERATING CONTROLS

- A. Provide low voltage, adjustable room thermostat to control burner operation, compressor and condenser fan, and supply fan to maintain temperature setting.
 - 1. Include system selector switch (heat-off-cool) and fan control switch (auto-on).
- B. Provide terminal strip on unit for connection of operating controls to remote panel by others. Control shall allow for two stages of heating and two stages cooling.
- C. Provide remote mounted fan control switch (on-auto).

- D. Provide night control energized by central time clock to maintain lower thermostat setting, lock out refrigeration, close outside air damper and open return air damper, stop supply air fan, for night and unoccupied operation. Provide time delay to maintain outside air damper closed and return air damper open after switching to day and occupied operation.
- E. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
- F. Control Valves: Field-installed, modulating, ball type with position tracking; see Section 253519.

2.08 OPERATING CONTROLS - SINGLE ZONE UNITS

- A. Electric solid state microcomputer based room thermostat, located as indicated in service area with remote sensor located as indicated.
- B. Room thermostat shall incorporate:
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set-up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from one hour to 31 days.
 - 5. Short cycle protection.
 - 6. Programming based on weekdays, Saturday and Sunday.
 - 7. Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.
- C. Room thermostat display shall include:
 - 1. Time of day.
 - 2. Actual room temperature.
 - 3. Programmed temperature.
 - 4. Programmed time.
 - 5. Duration of timed override.
 - 6. Day of week.
 - 7. System model indication: heating, cooling, auto, off, fan auto, fan on.
 - 8. Stage (heating or cooling) operation.
- D. Provide low limit thermostat in supply air to close outside air dampers and stop supply fan.

2.09 OPERATING CONTROLS - VARIABLE VOLUME UNITS

- A. Temperature transmitter located in supply air shall signal electronic logic panel to control mixing dampers and cooling in sequence. Mixing section shall operate as first stage of cooling and revert to minimum outside air above approximately 75 degrees F (24 degrees C) as determined by enthalpy of return and outdoor air.
- B. Control cooling by cycling compressors, cylinder unloading, and hot gas bypass.
- C. Control logic shall allow supply air reset under low load or airflow conditions.
- D. Seven day time clock with spring carry over (or electronic clock with battery backup) shall control unit on occupied/un-occupied schedule. At night, unit shall be off. Locate clock in remote control panel with status lights.
- E. Provide two stage morning warm-up thermostat to hold outdoor dampers closed and energize heat until return air temperature reaches set point.
- F. Provide within roof curb, by-pass dampers, bypassing air from supply fan discharge to return fan inlet to control duct static pressures. Control operation by sensing current to supply fan motor.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.02 INSTALLATION

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

- B. Install in accordance with NFPA 90A.
- C. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
- D. Locate remote panels where indicated on drawings.

3.03 SYSTEM STARTUP

- A. Prepare and start equipment. Adjust for proper operation.

3.04 MAINTENANCE

- A. Provide service and maintenance of packaged roof top units for one year from Date of Substantial Completion.
- B. Provide routine maintenance service with a two month interval as maximum time period between calls.
- C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.
- D. Provide 24-hour emergency service on breakdowns and malfunctions.
- E. After each service call, submit copy of service call work order or report that includes description of work performed.

END OF SECTION

SECTION 238216
AIR COILS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Refrigerant coils.

1.02 RELATED REQUIREMENTS

- A. Section 220719 - Plumbing Piping Insulation.
- B. Section 232300 - Refrigerant Piping.
- C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2020.

PART 2 PRODUCTS

2.01 REFRIGERANT COILS

- A. Tubes: 5/8 inch (16 mm) OD seamless copper or brass arranged in parallel or staggered pattern, expanded into fins, silver brazed joints.
- B. Fins: Aluminum or copper continuous plate type with full fin collars. Solder coat copper fin coils.
- C. Casing: Die formed channel frame of 16 gauge, 0.0598 inch (1.52 mm) galvanized steel with 3/8 inch (9.5 mm) mounting holes on 3 inch (75 mm) centers. Provide tube supports for coils longer than 36 inches (900 mm).
- D. Headers: Seamless copper or brass tubes with silver brazed joints.
- E. Liquid Distributors: Brass or copper venturi type distributor with seamless copper distributor tubes, 5/16 inch (8 mm) outside diameter; maximum 12 circuits per distributor.
- F. Testing: Air test under water at 300 psi (2070 kPa) for working pressure of 250 psi (1720 kPa); clean, dehydrate, and seal with dry nitrogen charge.
- G. Configuration: Down feed with bottom suction to prevent trapping of oil.
- H. Fin Spacing: 8 fins per inch (3.1 mm on center).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Install in ducts and casings in accordance with SMACNA (DCS).
 - 1. Support coil sections independent of piping on steel channel or double angle frames and secure to casings.
 - 2. Provide frames for maximum three coil sections.
 - 3. Arrange supports to avoid piercing drain pans.
 - 4. Provide airtight seal between coil and duct or casing.
- C. Install coils level. Install cleanable tube coils with 1:50 pitch.
- D. Make connections to coils with unions and flanges.
- E. Refrigerant Coils: Provide sight glass in liquid line within 12 inches (300 mm) of coil. Refer to Section 232300.
- F. Insulate headers located outside air flow as specified for piping. Refer to Section 220719.
- G. Electric Duct Coils: Wire in accordance with NFPA 70. Refer to Section 260583.

3.02 SCHEDULES

- A. Heating Coils:
- B. Cooling Coils:

1. Refrigerant:
 - a. Type:
 - b. Saturated Suction Temperature:

END OF SECTION

SECTION 238413
HUMIDIFIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Humidifier Units.
- B. Spray Pumps.

1.02 REFERENCE STANDARDS

- A. AHRI 610 (I-P) - Performance Rating Of Central System Humidifiers for Residential Applications 2014.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Units: AHRI 610 (I-P); factory assembled consisting of casing, tank, filters, spray pumps, water and drain connections.

2.02 CASING

- A. Assembly: Galvanized steel, minimum 0.0635 inch (1.6 mm) thick, reinforced and braced with galvanized steel angles and corrosion resistant cap screws.

2.03 DRAIN TANK

- A. Tank: Welded black steel 4 inches (100 mm) deep, 0.1345 inch (3.4 mm) thick, finished inside and out with zinc chromate, iron oxide phenolic resin paint and coated inside with asphalt coating.

2.04 FILTERS

- A. Filters: Two rows of neoprene coated filter mats in removable frames.

2.05 PUMPS

- A. Spray Assembly: Moisture resistant motor with built-in overload protection, brass impeller and cut-off blade, in galvanized well.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Connect unit to water supply. Provide gate valve on water supply line. Provide 3/4 inch (20 mm) hose bibb accessible from interior.
- C. Pipe drain and overflow to nearest floor drain.

END OF SECTION

SECTION 251400
INTEGRATED AUTOMATION LOCAL CONTROL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Smart Devices:
 - 1. Smart sensor (SS).
 - 2. Smart actuator (SA).
- B. Advanced application (programmable) controllers (AAC).
- C. Original equipment manufacturer (OEM) controllers.

1.02 RELATED REQUIREMENTS

- A. Section 233600 - Air Terminal Units.
- B. Section 250500 - Common Work Results for Integrated Automation.
- C. Section 253500 - Integrated Automation Instrumentation and Terminal Devices for HVAC.
- D. Section 253516 - Integrated Automation Sensors and Transmitters.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks 2020, with Errata and Amendments (2022).
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- E. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 SMART DEVICES

- A. Smart Sensor (SS):
 - 1. Device Type: Space refrigerant monitor (R- []) sensing.
 - 2. Features: Built-in display and cool-warm adjust slider or knob.
 - 3. Inputs: 3-universal (configurable).
 - 4. Output: 4-externally power binary.
 - 5. Occupancy Feedback: Alphanumeric display with changeable background color.
 - 6. Temperature Sensor: Platinum RTD within insulated thermoplastic enclosure.
 - 7. Combined Sensor Monitoring Range:
 - a. Humidity: 0 to 100 percent (non-condensing).
 - b. CO2 (Carbon dioxide): 0 to 2,000 ppm
 - c. Occupancy sensor.
 - d. VOC (Volatile Organic Compounds): 0 to 100 ppm.
 - 8. Communications Protocol: BACnet MS/TP per ASHRAE Std 135.
 - 9. Certification: BACnet Testing Laboratory (BTL) certified device listed under the BACnet Application Specific Controller (B-ASC) device profile in compliance with ASHRAE Std 135.
- B. Smart Actuator (SA):
 - 1. Actuator Type: Terminal unit damper actuator.
 - 2. Device Output: 1-relay (SPST).
 - 3. Device Inputs: 4-inputs, 0 to 5 VDC.
 - 4. Communications Protocol: BACnet IP per ASHRAE Std 135.

5. Certification: BACnet Testing Laboratory (BTL) certified device listed under the BACnet Smart Actuator (B-SA) profile in compliance with ASHRAE Std 135.

2.02 APPLICATION SPECIFIC CONTROLLERS

- A. Unitary Controller:
 1. Specific Application: Typical for fan coils (FC).
 2. Inputs: 4-universal (configurable).
 3. Outputs: 3-relays (configurable), 1-relay, and 4-universal (configurable).
 4. Subnet Communications: Proprietary data bus link for up to four network sensors.
 5. Display: Text-based terminal device in compliance with Section 253500 requirements.
 6. Memory: 512 Kb non-volatile battery-backed with a 12-bit memory bus.
 7. Accessories: Transformers, on-off switch, relays, transducers, vinyl-metallic adhesive identification tags, and programing software.
 8. Mounting:
 - a. Factory: Ship to manufacturer facility for factory-mounting and testing as a complete assembly.
- B. Terminal Unit Controller:
 1. Specific Application: Typical for variable air volume box (VAV).
 2. Inputs: 4-thermistor or dry contact, 2-universal and flow sensor.
 3. Outputs: 4-binary, 2-binary (internal), and integrated actuator.
 4. Dual high-speed Ethernet ports for bus type communications.
 5. Actuator: Electrically-operated non-reversible type with a 90 seconds stroke.
 6. Subnet communications in the form of proprietary data bus for external:
 - a. Input only module.
 - b. Output only module.
 - c. Universal I-O module (configurable).
 - d. Specific wireless connected t-stats (up to four).
 7. Subnet Communications: Proprietary data bus.
 8. PoE (powered over Ethernet) device. Output can be powered externally.
 9. Memory: 512 Kb non-volatile battery-backed with a 16-bit memory bus.
 10. BACnet Testing Laboratory (BTL) certified device listed under the BACnet Application Specific Controller (B-AAC) device profile in compliance with ASHRAE Std 135
 11. Accessories:
 - a. Zone thermostat with built-in cool-warm adjust knob, occupancy override, and occupancy sensor in compliance with Section 253516.
 - b. T-Stat Connectivity: Cable harness, 25 ft (7.7 m).
 - c. Transformers, on-off switch, relays, transducers, vinyl-metallic adhesive identification tags, and programing software.
 - d. Zone volume matching controller for exhaust terminal.
 12. Mounting:
 - a. Factory: Ship to terminal unit facility or deliver to Section 233600 manufacturer for factory-mounting and testing as a complete assembly.
- C. Air Handling Controller:
 1. Inputs: 8-binary (configurable) and 4-analog (configurable).
 2. Outputs: 8-binary (configurable) and 4-analog (configurable).
 3. Display: Graphics-based terminal device in compliance with Section 253500 requirements.
 4. Subnet Communications: Proprietary data bus.
 5. Memory: 16 Mb non-volatile battery-backed with a 32-bit memory bus.
 6. Accessories:
 - a. Zone thermostat with built-in cool-warm adjust knob, humidity sensor, occupancy override, and occupancy sensor in compliance with Section 253516.
 - b. T-Stat Connectivity: Cable harness, 75 ft (23 m).

- c. Accessories: Transformers, on-off switch, relays, transducers, vinyl-metallic adhesive identification tags, and programing software.
- 7. Mounting Requirements:
 - a. Factory: Ship to air handling unit manufacturer facility for factory-mounting and testing as a complete assembly.
 - b. Field Equipment: Control panel or manufacturer-prescribed compartment.
 - c. Rear panel door document pocket with a minimum size of 1/2 inch (13 mm).
 - d. Wire ducts sized to cover exposed wire runs.
 - e. Blank Space: Include a 20 percent internal space allowance for incidentals.
 - f. Self-supporting Structure: Provide metal channel (strut) framing system and related hardware to mount box on the floor or wall end next to equipment.

2.03 ADVANCED APPLICATION (PROGRAMMABLE) CONTROLLERS

- A. Inputs: 11-universal (configurable).
- B. Outputs: 6-binary and 4-analog (0-10 VDC).
- C. External Input-Output (I-O) Data Bus:
 - 1. Input only modules.
 - 2. Output only modules.
 - 3. Variable frequency drives (VFD's).
 - 4. Universal I-O module (configurable).
 - 5. Specific wired data integration modules.
- D. I-O Spare Capacity: Include a 20 percent object (point) allowance for incidentals.
- E. PoE (powered over Ethernet) device. Output can be powered externally.
- F. Wire Connections: Device to feature removable wire terminals.
- G. Memory: 32 Mb non-volatile battery-backed with a 32-bit memory bus.
- H. Certification: BACnet Testing Laboratory (BTL) certified device listed under the BACnet Advanced Application Controller (B-AAC) profile in compliance with ASHRAE Std 135.
- I. Mounting Requirements:
 - 1. Factory: Ship to air handling unit manufacturer facility for factory-mounting and testing as a complete assembly.
 - 2. Field Enclosure: Provide control panel complying with NEMA 250 and UL 50 or UL 50E use in non-hazardous locations with:
 - a. Field Enclosure: Minimum size of 24 by 36 inch (610 by 920 mm) with key-lockable, lever door handle for:
 - 1) Indoors and Plenums: NEMA 250, Type 1.
 - 2) Mechanical Rooms: NEMA 250, Type 2, using any mounting orientation.
 - 3) Outdoors: NEMA 250, Type 4 or Type 4X with built-in heaters for extreme ambient conditions.
 - 4) Listed in compliance with UL 50 or UL 50E use in non-hazardous locations.
 - b. Document Pocket: Backdoor-installed with a minimum size of 1/2 inch (13 mm).
 - c. Wire ducts sized to cover exposed wire runs.
 - d. Blank Space: Include a 20 percent internal space allowance for incidentals.
 - e. Self-supporting Structure: Provide metal channel (strut) framing system and related hardware to mount box on the floor or wall end next to equipment.

2.04 ORIGINAL EQUIPMENT MANUFACTURER (OEM) CONTROLLERS

- A. Requirement: Connect OEM (factory-installed) controllers such as variable frequency drivers (VFD's), variable speed drives (VSD's), HVAC equipment including terminal units, plumbing, and fire protection equipment.
- B. Gateway: Provide external data exchange interface of the device-poll type for products with different communications protocol than BACnet IP per ASHRAE Std 135.

2.05 REMOTE TERMINAL UNIT (RTU)

- A. Inputs: 6-binary and 8-analog (configurable).
- B. Outputs: 8-binary (configurable) and 4-analog (configurable).
- C. Form Factor: Expansion module, board, or card.
- D. Communications Protocol: BACnet IP per ASHRAE Std 135.
- E. Accessories: Transformers, on-off switch, relays, transducers, vinyl-metallic adhesive identification tags, and programming software.
- F. Enclosure Requirements:
 - 1. Shared Space: House multiple controllers within the same enclosure.
 - 2. Minimum size of 24 by 24 inch (610 by 610 mm) with key-lockable lever door handle for:
 - a. Mechanical Rooms: NEMA 250, Type 2, using any mounting orientation.
 - b. Outdoors: NEMA 250, Type 4 or Type 4X with built-in heaters for extreme ambient conditions.
 - c. Listed in compliance with UL 50 or UL 50E use in non-hazardous locations.
 - 3. Document Pocket: Backdoor-installed with a minimum size of 1/2 inch (13 mm).
 - 4. Wire ducts sized to cover exposed wire runs.
 - 5. Blank Space: Include a 20 percent internal space allowance for incidentals.
 - 6. Self-supporting Structure: Provide metal channel (strut) framing system and related hardware to mount box on the floor or wall end next to equipment.

2.06 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- A. Backplane (Base): Self-contained module unit featuring power supply and CPU.
- B. Terminal Blocks: Panel-mounted screw terminal block segments connected via ribbon to plug-in port on module.
- C. Memory: Programming and data holding capacity of 7.5 Kb.
- D. Access Ports: USB and RS-232.
- E. Data Logging Storage Capacity: 8 Mb, loaded into microXD card.
- F. Communications Protocol: EtherNet/IP per ODVA (CIP).
- G. High Availability (Redundant) Ready: Provide two communication modules.
- H. Integrated Automation Gateway: Provide a device-poll data link card or module with BACnet IP per ASHRAE Std 135 as the communications protocol.
- I. Display: Text-based terminal device in compliance with Section 253500 requirements.
- J. Inputs: 4-discrete.
- K. Outputs: 4-discrete.
- L. Accessories: Transformers, on-off switch, relays, transducers, vinyl-metallic adhesive identification tags, and programming software.
- M. Enclosure Requirements:
 - 1. Shared Space: House multiple controllers within the same enclosure.
 - 2. Minimum size of 24 by 24 inch (610 by 610 mm) with key-lockable, lever-type right door handle for use on:
 - a. Mechanical Rooms: NEMA 250, Type 2, using any mounting orientation.
 - b. Outdoors: NEMA 250, Type 4 or Type 4X with built-in heaters for extreme ambient conditions.
 - c. Listed in compliance with UL 50 or UL 50E use in non-hazardous locations.
 - 3. Document Pocket: Backdoor-installed with a minimum size of 1/2 inch (13 mm).
 - 4. Wire ducts sized to cover exposed wire runs.
 - 5. Blank Space: Include a 20 percent internal space allowance for incidentals.

6. Self-supporting Structure: Provide metal channel (strut) framing system and related hardware to mount box on the floor or wall end next to equipment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products on respective equipment with low voltage wiring in compliance with NFPA 70.
- B. See Section 250500 for related installation and execution requirements.
- C. Programming: Configure, download, test, and debug software codes per controller type to match intended application specific, custom, or project-drawing-listed sequences of operation.

END OF SECTION

SECTION 253513
INTEGRATED AUTOMATION ACTUATORS AND OPERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manual operators.
- B. Electric actuators.

1.02 RELATED REQUIREMENTS

- A. Section 250500 - Common Work Results for Integrated Automation.

1.03 REFERENCE STANDARDS

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- B. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- C. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 ACTUATORS AND OPERATORS - GENERAL

- A. Actuator Capacity: Next torque size above calculated load requirement for single units. Increase selected capacity by 25 percent when multiple units are required.
- B. Assembly: Products field-installed into scheduled dampers and valves.
- C. Fire Protection Systems:
 - 1. Run Time: 60 second travel with a 20 second spring return on a 250 degrees F (121 degrees C) rated damper.
- D. Environmental Operating Range:
 - 1. Temperature: From minus 22 to 122 degrees F (minus 30 to 50 degrees C).
 - 2. Humidity: 5 to 90 percent RH (non-condensing).

2.02 MANUAL OPERATORS

- A. Provide latching operator per actuator.
- B. Operator Type: Hand quadrant lever.

2.03 ELECTRIC ACTUATORS

- A. Mechanical Configuration:
 - 1. On/Off or 2-Position:
 - a. Input: Line voltage from starter or VFD.
 - b. Power: 24 VAC.
 - c. Position Feedback: Dry contact.
 - d. Stroke Duration: 60 seconds, adjustable.
 - e. Fail Safe Control: Spring-return.
 - 2. Floating or Three-Position:
 - a. Input: Dual, 24 VAC.
 - b. Power: 24 VAC.
 - c. Position Feedback: Dry contacts, (open-closed status).
 - d. Stroke Duration: 90 seconds, adjustable.
 - e. Fail Safe Control: Spring-return.
- B. Angle of Rotation: 95-degree, adjustable range with mechanical end stop.
- C. Motor Direction: Clock wise (CW) counter-clock wise (CCW) selectable.
- D. Position Indicator: Scale indicator with tracking pointer.

- E. Overload Protection Type: Electronic.
- F. Electrical Protection: Double-insulated.
- G. Enclosure Rating: Listed as complying with NEMA 250 and UL 50 or UL 50E use in non-hazardous locations such as:
 - 1. Indoors and Plenums: NEMA 250, Type 1.
 - 2. Mechanical Rooms: NEMA 250, Type 2, using any mounting orientation.
 - 3. Outdoors: NEMA 250, Type 4 or Type 4X with built-in heaters for extreme ambient conditions.
- H. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Auxiliary switches (SPST).
 - 2. Battery backup.
 - 3. Conduit connector.
 - 4. Gaskets.
 - 5. Potentiometer interface.
 - 6. Pulse-width modulation (PWM) interface.
 - 7. Resistor kit.
 - 8. Terminal strip.
 - 9. Thermal sensors.
 - 10. Transformer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Designate actuators and related accessories for factory assembly on assigned device in the form of valve or damper assembly. In turn assembly is to be handled by applicable installers in accordance with Division 23 requirements.
- B. Terminations: Leave a minimum of 4 inch (102 mm) of loop per cable or wire end to ease future servicing needs. Accommodate excess neatly turned into a loop inside junction or actuator access box.
- C. See Section 250500 for other related installation and execution requirements.

END OF SECTION

SECTION 253516
INTEGRATED AUTOMATION SENSORS AND TRANSMITTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sensors:
 - 1. Temperature sensors.
 - 2. Relative humidity and dewpoint sensors.
 - 3. CO2 (carbon dioxide) sensor.
 - 4. Air or gas flow; differential pressure type.
 - 5. Air or gas flow; thermal dispersion type.
- B. Pressure Sensors and Transmitters:
 - 1. Pressure sensors.
 - 2. Differential pressure sensors.
- C. Flow Sensors and Transmitters:
 - 1. Flow meters for air and other gases.
- D. Switches:
 - 1. Temperature switch (thermostat).
 - 2. Low-limit temperature cutout switch (freezestat).
 - 3. Wet-temperature switch (aquastat).
 - 4. Humidity switch (humidistat).
 - 5. Pressure and differential pressure switch.
 - 6. Flow switch.
 - 7. Current switch.
 - 8. Damper position switch.
 - 9. Relays.

1.02 RELATED REQUIREMENTS

- A. Section 250500 - Common Work Results for Integrated Automation.

1.03 REFERENCE STANDARDS

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

PART 2 PRODUCTS

2.01 SENSORS AND SWITCHES - GENERAL REQUIREMENTS

- A. Unless otherwise indicated, each sensor provided accuracy is to be within one percent of its full-scale measuring span.
- B. Select devices such that their expected measured value or setpoints are at mid-span.
- C. Sensor and Switch Identification:
 - 1. Tag: Custom metalized polyester label, printed.
 - 2. Information: Show point (object) tag and equipment tag.
 - 3. Size: 1/2 by 1-1/2 inches (12.7 by 38.1 mm).

2.02 SENSORS

- A. Temperature Sensors:
 - 1. Room (Zone) Temperature (Thermostat):
 - a. Sensor: Platinum thin-film RTD element, 1,000 ohms at 70 degrees F (21 degrees C) element inside insulated thermoplastic enclosure.
 - b. Monitoring Range: From 32 to 104 degrees F (0 to 40 degrees C).
 - c. Output: Two-wire, 0 to 10 VDC.
 - d. Electrical Connection: Screw terminal block.
 - 2. Outdoor Temperature:

- a. Sensor: Platinum, 1,000 ohms at 70 degrees F (21 degrees C) thin-film RTD element inside insulated thermoplastic enclosure with sun shield.
 - b. Monitoring Range: From minus 50 to 140 degrees F (minus 48 to 60 degrees C).
 - c. Mounting: Place on wall box mounting pad or base.
 - d. Power Input: 14 to 30 VDC.
 - e. Output: Two-wire, 0 to 10 VDC.
 - f. Electrical Connection: Built-in screw terminal block.
3. Probe:
- a. Sensor: Platinum thin-film RTD element, 1,000 ohms at 70 degrees F (21 degrees C).
 - b. Monitoring Range: From 32 to 104 degrees F (0 to 40 degrees C).
 - c. Mounting Categories:
 - 1) Ceiling:
 - (a) Length: 6 inches (152 mm).
 - (b) Accessories: Include cover, sensor holder, and single gang box insulation.
 - 2) Duct:
 - (a) Length: 8 inches (203 mm).
 - (b) Holding-rod: Required for lengths over 12 inches (152 mm).
 - (c) Location: Indoor ductwork, fasten inside Type LB conduit body.
 - 3) Averaging Coil-discharge:
 - (a) Length: 8 feet (2.45 meters).
 - (b) Mounting: Use surface-fastened rods to hold it in place.
 - (c) Parallel Elements: Per manufacturer recommendation for coil size.
 - 4) Pipe :
 - (a) Length: 6 inches (152 mm).
 - (b) Insertion: Fitted pipe well.
 - (c) Well Material:
 - d. Power Input: 14 to 30 VDC.
 - e. Output: Passive RTD.
 - f. Electrical Connection: Two-wire, 18 to 22 AWG leads.
- B. Relative Humidity and Dewpoint Sensor:
- 1. Connection: Screw terminal block.
 - 2. Mounting Style: Duct.
 - 3. Monitoring Range: 0 to 95 percent (noncondensing).
 - 4. Response Time: 30 to 50 milliseconds.
 - 5. Accuracy: Two percent.
 - 6. Power Input: None, device is loop-powered.
 - 7. Output: Two-wire, 0 to 10 VDC.
- C. CO2 (Carbon Dioxide) Sensor:
- 1. Connection: Screw terminal block.
 - 2. Mounting Style: Duct.
 - 3. Monitoring Range: 0 to 2,000 ppm.
 - 4. Response Time: 30 to 50 milliseconds.
 - 5. Power Input: None, device is loop-powered.
 - 6. Output: Two-wire, 0 to 10 VDC.
- D. Air or Gas Flow; Thermal Dispersion Type:
- 1. Configuration: Duct or plenum inserted assembly using up to eight water-resistant thermal dispersion sensors per metal probe wired into external access box holding self-diagnosing sensor interface electronics with respective field wire and cable landing terminals.
 - 2. Signal Monitoring Range:
 - a. Air Velocity: 0 to 5,000 fpm (0 to 25 m/sec) converted to airflow using section area.
 - b. Temperature: Minus 20 to 120 degrees F (Minus 29 to 49 degrees C).

3. Accuracy: Plus or minus 3 percent with a plus or minus 0.25 percent repeatability over listed range. Includes means to zero, adjust, and calibrate outputs.
4. Access Box: NEMA 250, Type 1 with hinged cover housing and cable access ports.
5. Outputs: Two-wire, 4 to 20 mA, for each measured signal, configurable.

2.03 PRESSURE SENSORS AND TRANSMITTERS

- A. Pressure Sensors:
 1. Measurement: Apply for absolute pressure and static pressure.
 2. Mounting Style: DIN rail, duct, outdoor, surface, or wall box, single gang.
 3. Airflow Monitoring Range: 0 to 10 in-wc (0 to 2.48 kPa).
 4. Response Time: 30 to 50 milliseconds.
 5. Linearity: 0.1 percent of calibrated span.
 6. Minimum Overpressure: 150 percent over highest range value.
 7. Power Input: None, device is loop-powered.
 8. Output: Two-wire, 0 to 10 VDC.
 9. Hi/Lo Port to Tip (Sensor) Tube Material: Polyvinyl, black.
 10. Process Connection: 1 inch (25 mm).
- B. Differential Pressure Sensors:
 1. Measurement: Apply for static pressure.
 2. Mounting Style: DIN-rail, duct, outdoor, surface, or wall box, single gang.
 3. Airflow Monitoring Range: 0 to 0.25 in-wc (0 to 62.2 Pa).
 4. Response Time: 30 to 50 milliseconds.
 5. Linearity: 0.1 percent of calibrated span.
 6. Minimum Overpressure: 150 percent over highest range value.
 7. Power Input: None, device is loop-powered.
 8. Output: Two-wire, 0 to 10 VDC.
 9. Hi/Lo Port to Tip/Sensor Tube Material: Polyvinyl, black.
 10. Process Connection: 1 inch (25 mm).

2.04 FLOW SENSORS AND TRANSMITTERS

- A. Flow Meters for Air or Other Gases:
 1. Airflow Sensor Type: Probe, duct inserted with built-in transmitter.
 2. Monitoring Range: As indicated on drawings.
 3. Turndown: 10 to 1.
 4. Response Time: 30 to 50 milliseconds.
 5. Linearity: 0.1 percent of calibrated span.
 6. Minimum Overpressure: 150 percent over highest range value.
 7. Power Input: None, loop-powered device.
 8. Output: Two-wire, 4 to 20 mA.
 9. Housing: NEMA 250 Type 1.

2.05 SWITCHES

- A. General:
 1. Switch Type: Electro-mechanical type unless otherwise indicated.
 2. Contact Type: SPST (single-pole single-throw) unless otherwise indicated.
 3. Load Service: Select contact load rating as follows:
- B. Temperature Switch (thermostat):
 1. Device Type: Bulb sensor, electromechanics.
 2. Setpoint Adjust: Slider.
 3. Application: Provide for 2-speed fans
 4. Sensing Range: 40 to 90 degrees F (4 to 32 degrees C).
 5. Mounting: Locate on duct, equipment, pipe surface, or wall surface.
 6. Housing Cover: Plastic.

- C. Low-Limit Temperature Cutout Switch (low-limit thermostat or freezestat):
 - 1. Configuration: Digital module tied to sensor-assembly.
 - 2. Sensing Length: 4 feet (1.2 m).
 - 3. Setpoint Adjust: Slider.
 - 4. Switch Type: SPDT, snap-action, form C in dust-protected enclosure.
 - 5. Mounting: Locate on cooling coil intake side.
 - 6. Field Interface: Connect load line-voltage to stat.
 - 7. Electrical Rating: Pilot duty, 125 VA at 125 to 600 VAC.
- D. Wet-Temperature Switch (aquastat):
 - 1. Device Type: Bi-metallic.
 - 2. Setpoint Adjust: Knob.
 - 3. Application: Water cooling, dump at 140 degrees F (60 degrees C).
 - 4. Pipe or Equipment-mounted:
 - a. Probe: Install on pipe well.
 - b. Probe Length: 6 inches (152 mm).
 - c. Material for Water or Brine Use: Brass.
 - d. Material for Steam and Non-HVAC Use: 316 stainless steel.
 - e. Accessories: Provide thermal conductive grease.
- E. Pressure and Differential Pressure Switch:
 - 1. Measurement: Apply for static pressure.
 - 2. Measured Material: For gases and fluids such as water, brine and noncorrosive fluids.
 - 3. Monitoring Range: As indicated on drawings in-wc (mm hg).
 - 4. Minimum Overpressure: 150 percent over highest range value.
 - 5. Hi/Lo Port to Tip (Sensor) Tube Material: Polyvinyl, black.
 - 6. Process Connection: 1 inch (25 mm).
- F. Flow Switch:
 - 1. Measured Material: For gases and fluids such as water, brine and noncorrosive fluids.
 - 2. Device Type: Vane-operated.
 - 3. Mounting: Install on duct or pipe.
 - 4. Setpoint Adjust: Screw, concealed.
 - 5. Measuring Range: As indicated on drawings.
 - 6. Minimum Overpressure: 150 percent over highest range value.
 - 7. Process Connection: 1 inch (25 mm) threaded pipe fitting.
- G. Current Switch:
 - 1. Configuration: Solid-state, electro-mechanical.
 - 2. UL Listed Core Type: Single.
 - 3. Device Type: Current.
 - 4. Relay Type: Fixed trip.
 - 5. Monitoring Range: 20 Amperes.
 - 6. Load Rating: 25 Amperes.
- H. Damper Position Switch:
 - 1. Type: Damper-blade attached lever.
- I. Relays:
 - 1. Device Type: General purpose.
 - 2. Rating: 10 Amperes at 120 to 277 VAC.
 - 3. Mounting: Panel.
 - 4. Contact Type: SPDT (single-pole double-throw).
 - 5. Feedback: Integral LED.
 - 6. Load Rating: 10 Amperes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide and install products as indicated on project drawings or manufacturer-provided schematics.
- B. See Section 250500 for other related installation and execution requirements.

END OF SECTION

SECTION 26 05 19
LOW VOLTAGE POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Copper building wire rated 600 V or less.
- B. Connectors, splices, and terminations rated 600 V and less.

1.02 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.01 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Conductor Insulation:
 - 1. Type THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.

2.02 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper or Bronze.
 - 2. Type: One or Two hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. 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.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.04 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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm).

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.
 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
1. Procedures used.
 2. Results that comply with requirements.

3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.02 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- 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. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.03 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- E. Conduit Hubs: Mechanical type, terminal with threaded hub.
- F. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- G. Straps: Solid copper, cast-bronze clamp or copper lugs. Rated for 600 A.
- H. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

2.04 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

3.03 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.04 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.

- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
 - 1. building's foundation.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Eye nuts.
 - e. Fasteners.
 - f. Anchors.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.03 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 43 00 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. Component Importance Factor: 1.0.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 2. Material for Channel, Fittings, and Accessories: Galvanized steel, Stainless steel, Type 304, or Stainless steel, Type 316. Material for channel fittings and accessories must be of the same material.
 3. Channel Width: Selected for applicable load criteria with minimum size being 1-5/8 inches (41.25 mm).
 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel, Stainless-steel or Glass-fiber-resin hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
 - 5. Toggle Bolts: All or Stainless-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
- B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.

- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate[by means that comply with seismic-restraint strength and anchorage requirements].
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.04 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

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SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Type EMT raceways and elbows.
2. Type ENT raceways and fittings.
3. Type ERMC raceways, elbows, couplings, and nipples.
4. Type ERMC-S raceways, elbows, couplings, and nipples.
5. Type FMC raceways.
6. Type FMT raceways.
7. Type LFMC raceways.
8. Fittings for conduit, tubing, and cable.
9. Wireways and auxiliary gutters.
10. Metallic outlet boxes, device boxes, rings, and covers.
11. Cabinets, cutout boxes, junction boxes, pull boxes, and miscellaneous enclosures.

B. Related Requirements:

1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

1.02 ACTION SUBMITTALS

A. Product Data: For the following:

1. Wireways and auxiliary gutters.
2. Surface metal raceways.
3. Cabinets, cutout boxes, and miscellaneous enclosures.

1.03 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions:

1. For Type ERMC-S-PVC.

PART 2 - PRODUCTS

2.01 TYPE EMT RACEWAYS AND ELBOWS

A. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:

- 1) Reference Standards: UL 797 and UL Category Control Number FJMX.
- 2) Material: Steel.
- 3) Exterior Coating: Zinc.
- 4) Interior Coating: Zinc with organic top coating.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch (21 mm).

2.02 ERM C RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Stainless Steel Electrical Rigid Metal Conduit (ERM C-SS), Elbows, Couplings, and Nipples:

1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 6A and UL Category Control Number DYWV.
 - 2) Material: Stainless steel.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch (21 mm).

2.03 TYPE ERM C-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Galvanized-Steel Electrical Rigid Metal Conduit (ERM C-S-G), Elbows, Couplings, and Nipples:

1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 6 and UL Category Control Number DYIX.
 - 2) Exterior Coating: Zinc.
 - 3) Interior Coating: Zinc with organic top coating.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch (21 mm).

B. PVC-Coated-Steel Electrical Rigid Metal Conduit (ERM C-S-PVC), Elbows, Couplings, and Nipples:

1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 6 and UL Category Control Number DYIX.
 - 2) Exterior Coating: PVC complying with NEMA RN 1.

- 3) Interior Coating: Zinc with organic top coating.
- 4) Fittings for PVC-Coated Conduit:
 - (a) Minimum coating thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
 - (b) Conduit bodies must be Form 8 with an effective seal and a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours must be available. Conduit bodies must be supplied with plastic-encapsulated stainless steel cover screws.
 - (c) Form 2 inch (51 mm) long or one pipe diameter long, whichever is less, PVC sleeve at openings of female fittings, except unions. Inside sleeve diameter must be matched to outside diameter of metal conduit.
 - (d) PVC coating on the outside of conduit couplings must be protected from tool damage during installation.
 - (e) Female threads on fittings and couplings must be protected by urethane coating.
 - (f) Fittings must be from same manufacturer as conduit.
 - (g) Beam clamps and U bolts must be formed and sized to fit outside diameter of coated conduit. Plastic-encapsulated nuts must cover the exposed portions of threads.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch (21 mm).
 - 2) Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.04 TYPE FMC RACEWAYS

A. Steel Flexible Metal Conduit (FMC-S):

1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standard: UL 1 and UL Category Control Number DXUZ.
 - 2) Material: Steel.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch (21 mm).

2.05 TYPE LFMC RACEWAYS

A. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standard: UL 360 and UL Category Control Number DXHR.
 - 2) Material: Steel.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch (21 mm).

2.06 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Fittings for Type ERM Raceways:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number DWTT.
 - 2) Material: Steel.
 - 3) Coupling Method: Compression coupling.

B. Fittings for Type EMT Raceways:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number FKAV.
 - 2) Material: Steel.
 - 3) Coupling Method: Compression coupling or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.

C. Fittings for Type FMC Raceways:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number ILNR.

D. Fittings for Type LFMC and Type LFNC Raceways:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

- 1) Reference Standards: UL 514B and UL Category Control Number DXAS.

2.07 WIREWAYS AND AUXILIARY GUTTERS

A. Metal Wireways and Auxiliary Gutters:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

- 1) Reference Standards: UL 870 and UL Category Control Number ZOYX.
- 2) Fittings and Accessories: Include covers, 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.
- 3) Finish: Manufacturer's standard enamel finish.
- 4) Wireway Covers: Hinged type unless otherwise indicated.

2.08 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:
 - 1) Material: Sheet steel.
 - 2) Sheet Metal Depth: Minimum 2 inch (50 mm).

B. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.

C. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:
 - 1) Material: Sheet steel.
 - 2) Sheet Metal Depth: minimum 2 inch (50 mm).

2.09 CABINETS, CUTOOT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

A. Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL Category Control Number BGUZ.
 - (a) Non-Environmental Characteristics: UL 50.
 - (b) Environmental Characteristics: UL 50E.

B. Outdoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL Category Control Number BGUZ.
 - (a) Non-Environmental Characteristics: UL 50.
 - (b) Environmental Characteristics: UL 50E.

PART 3 - EXECUTION

3.01 SELECTION OF RACEWAYS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 - 1. Exposed Conduit: ERM C.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- C. Indoors:
 - 1. Exposed and Subject to Physical Damage: ERM C. Raceway locations include the following:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - 2. Exposed, Not Subject to Physical Damage: EMT.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Damp or Wet Locations: ERM C.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC.
- D. Stub-ups to Above Recessed Ceilings: Provide EMT or ERM C for raceways.
- E. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
 - 1. ERM C: Provide threaded type fittings unless otherwise indicated.

3.02 SELECTION OF BOXES AND ENCLOSURES

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 - 1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4.
 - c. Locations Subject to Potential Flooding: Type 6P.
 - d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
 - 2. Indoors:

- a. Type 1 unless otherwise indicated.
- b. Damp or Dusty Locations: Type 12.
- C. Exposed Boxes Installed Less Than 6.5 ft. (2 m) Above Floor:
 - 1. Provide cast-metal boxes.
 - 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.03 INSTALLATION OF RACEWAYS

A. Installation Standards:

- 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
- 2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- 3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- 4. Comply with NECA NEIS 101 for installation of steel raceways.
- 5. Comply with NECA NEIS 102 for installation of aluminum raceways.
- 6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
- 7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
- 8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4 inch (35 mm) trade size and insulated throat metal bushings on 1-1/2 inch (41 mm) trade size and larger conduits terminated with locknuts.
- 9. Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

B. General Requirements for Installation of Raceways:

- 1. Complete raceway installation before starting conductor installation.
- 2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft. (0.6 m) above finished floor.
- 3. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch (300 mm) of changes in direction.
- 4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
- 5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

6. Support conduit within 12 inch (300 mm) of enclosures to which attached.
7. Types ERM C:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
8. Type ERM C-S-PVC:
 - a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
 - b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERM C-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERM C-S-PVC raceway.
 - c. Coat field-cut threads on PVC-coated raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.
9. Types FMC, LFMC:
 - a. Comply with NEMA RV 3. Provide a maximum of 36 inch (915 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
10. Types PVC and EPEC:
 - a. Do not install Type PVC or Type EPEC conduit where ambient temperature exceeds 122 deg F (50 deg C). Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's written instructions for solvent welding and fittings.
- C. Raceways Embedded in Slabs:
 1. Run raceways larger than 1 inch (27 mm) trade size below concrete slab.
 2. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 3. Arrange raceways to ensure that each is surrounded by a minimum of 1 inch (25 mm) of concrete without voids.
 4. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
- D. Stub-ups to Above Recessed Ceilings:
 1. Provide EMT or ERM C for raceways.
 2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- E. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
1. ERM-C-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 2. EMT: Provide setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
- F. Expansion-Joint Fittings:
1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F (17 deg C) and that have straight-run length that exceeds 25 ft. (7.6 m). Install in runs of aboveground ERM-C and EMT conduit that are located where environmental temperature change may exceed 100 deg F (55 deg C) and that have straight-run length that exceeds 100 ft. (30 m).
 2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

3.04 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

- C. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- D. Locate boxes so that cover or plate will not span different building finishes.
- E. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- F. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- G. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- H. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

3.05 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.06 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.07 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION

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SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Precast concrete handholes.
6. Fiberglass handholes and boxes.
7. Utility structure accessories.

1.02 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
1. Two or more ducts installed in parallel, with or without additional casing materials.
 2. Multiple duct banks.
- D. GRC: Galvanized rigid (steel) conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.
2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for manholes, handholes, boxes.
4. Include underground-line warning tape.
5. Include warning planks.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.

- c. Include reinforcement details.
 - d. Include grounding details.
 - e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - f. Include joint details.
2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
- a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include cover design.
 - d. Include grounding details.
 - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.04 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C858.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.05 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is 36 inches (900 mm) below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Coated Steel Conduit: PVC-coated GRC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.02 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
- C. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.04 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- B. Comply with ASTM C858 for design and manufacturing processes.
- C. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
 - 1. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - 2. Cover Handle: Recessed.
- D. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- E. Cover Legend: Molded lettering, "ELECTRIC."
- F. Configuration: Units shall be designed for flush burial and have closed or integral closed bottom unless otherwise indicated.
- G. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- H. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
 - 1. Center window location.
 - 2. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
 - 4. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - 5. Knockout panels shall be 1-1/2 to 2 inches (38 to 50 mm) thick.

- I. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.05 FIBERGLASS HANDHOLES AND BOXES

- A. Description: Molded of fiberglass-reinforced polyester resin, with covers made of polymer concrete, reinforced concrete, cast iron, hot-dip galvanized-steel diamond plate or fiberglass.
- B. <Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- C. Color: Green.
- D. Configuration: Units shall be designed for flush burial and have open or integral closed bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- G. Cover Legend: Molded lettering, "ELECTRIC."
- H. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- I. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.06 UTILITY STRUCTURE ACCESSORIES

- A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.
 1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.
- C. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (31-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.
- D. Ground Rod Sleeve: 3-inch (75-mm) PVC sleeve in manhole floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the ducts routed from the facility.
- E. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

2.07 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C1037.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

3.02 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC RNC, direct-buried unless otherwise indicated.
- B. Duct for Electrical Branch Circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- C. Stub-ups: Concrete-encased PVC-coated GRC.

3.03 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
 - 2. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
 - 3. Cover design load shall not exceed the design load of the handhole or box.

3.04 EARTHWORK

- A. Excavation and Backfill: Comply with Section 31 23 00 "Earthwork," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures.

3.05 DUCT AND DUCT-BANK INSTALLATION

- A. Install duct according to NEMA TCB 2.

- B. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm), both horizontally and vertically, at other locations unless otherwise indicated.
- D. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- E. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- F. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell, without reducing duct slope and without forming a trap in the line.
 - 2. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- H. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- I. Pulling Cord: Install 200-lbf- (1000-N-) test nylon cord in empty ducts.
- J. Direct-Buried Duct and Duct Bank:
 - 1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 31 23 00 "Earthwork" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
 - 2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
 - 3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
 - 4. Depth: Install top of duct at least 36 inches (900 mm) below finished grade unless otherwise indicated.
 - 5. Set elevation of bottom of duct bank below frost line.
 - 6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.

7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
8. Install duct with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and communications duct.
9. Elbows: Install manufactured duct elbows, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
10. Install manufactured GRC elbows for stub-ups and at changes of direction in duct.
 - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches (100 mm) above finished floor and minimum 3 inches (75 mm) from conduit side to edge of slab.
 - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches (100 mm) above finished floor and no less than 3 inches (75 mm) from conduit side to edge of slab.
11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
 - a. Place minimum 3 inches (75 mm) of sand as a bed for duct. Place sand to a minimum of 6 inches (150 mm) above top level of duct.
- K. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches (300 mm) above all concrete-encased duct and duct banks. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.06 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

- A. Precast Concrete Handhole and Manhole Installation:
 - 1. Comply with ASTM C891 unless otherwise indicated.
 - 2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
 - 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
 - 1. Install handholes with bottom below frost line, below grade.
 - 2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
 - 3. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.07 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below frost line, below grade.
- E. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- F. For enclosures installed subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.08 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.09 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
 - 1. Sweep floor, removing dirt and debris.
 - 2. Remove foreign material.

END OF SECTION

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SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 ROUND SLEEVES

A. Pipe Sleeves, PVC:

1. Description: ASTM D1785, Schedule 40.

B. Sheet Metal Sleeves, Galvanized Steel, Round:

1. Description: Galvanized-steel sheet; thickness not less than 0.0239 inch (0.6 mm); round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.02 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:
 - a. Material: Galvanized sheet steel.
 - b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inch (1270 mm) and with no side larger than 16 inch (400 mm), thickness must be 0.052 inch (1.3 mm).
 - 2) For sleeve cross-section rectangle perimeter not less than 50 inch (1270 mm) or with one or more sides larger than 16 inch (400 mm), thickness must be 0.138 inch (3.5 mm).

2.03 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

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: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.04 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 2. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- E. Underground, Exterior-Wall and Floor Penetrations:
 1. Install steel pipe sleeves. Size sleeves to allow for 1 inch (25 mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.02 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.03 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Signs.
6. Paint for identification.
7. Fasteners for labels and signs.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

- A. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.

2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
3. Color for Neutral: White.
4. Color for Equipment Grounds: Green.
- B. Warning labels and signs shall include, but are not limited to, the following legends:
 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
- C. Equipment Identification Labels:
 1. Black letters on a white field.

2.03 LABELS

- A. Self-Adhesive Wraparound Labels: Preprinted or Write-on, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed
 2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer. Or Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
 - c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

- A. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.05 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- C. Underground-Line Warning Tape:
 1. Tape:

- a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:
- a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE".
- D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.06 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
 2. Thickness:
 - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
 - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
 - c. Engraved legend with white letters on a dark gray background.
 - d. Self-adhesive.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.07 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. 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

3.01 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.

- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- H. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- I. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- J. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- K. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- L. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- M. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- N. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench [or concrete envelope] exceeds 16 inches (400 mm) overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- O. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- P. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive vinyl tape applied in bands.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels or self-adhesive vinyl tape to identify the phase.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
 2. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 1. Apply to exterior of door, cover, or other access.
- F. Arc Flash Warning Labeling: Self-adhesive labels.
- G. Equipment Identification Labels:
 1. Indoor Equipment: Self-adhesive label or Laminated acrylic or melamine plastic sign.
 2. Outdoor Equipment: Laminated acrylic or melamine sign or Stenciled legend 4 inches (100 mm) high.
 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Enclosed switches.
 - e. Enclosed circuit breakers.
 - f. Enclosed controllers.

- g. Variable-speed controllers.

END OF SECTION

SECTION 26 22 13

LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
 - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Include diagrams for power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
 - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
 - 2. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- B. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturer's may include: Square D, Eaton, ABB, GE, Siemens, Cutler-Hammer, and Maddox.

2.02 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

- B. Comply with NFPA 70.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
 - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 - 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.03 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
 - 1. One leg per phase.
 - 2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
 - 3. Grounded to enclosure.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Coil Material: Aluminum or Copper.
 - 2. Internal Coil Connections: Brazed or pressure type.
 - 3. Terminal Connections: Welded or Bolted.
- D. Enclosure: Ventilated.
 - 1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
 - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
 - 3. Wiring Compartment: Sized for conduit entry and wiring installation.
 - 4. Finish: Comply with NEMA 250.
 - a. Finish Color: Gray weather-resistant enamel.
- E. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- F. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- G. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
 - 1. 50.01 to 150.00 kVA: 50 dBA for K-factors of 1, 4, and 9.
 - 2. 150.01 to 300.00 kVA: 55 dBA for K-factors of 1, 4, and 9.

2.04 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.05 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
 - 1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
 - 2. Ratio tests at rated voltage connections and at all tap connections.
 - 3. Phase relation and polarity tests at rated voltage connections.
 - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
 - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
 - 6. Applied and induced tensile tests.
 - 7. Regulation and efficiency at rated load and voltage.
 - 8. Insulation-Resistance Tests:
 - a. High-voltage to ground.
 - b. Low-voltage to ground.
 - c. High-voltage to low-voltage.
 - 9. Temperature tests.
- B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Construct concrete bases according to and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
 - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Secure transformer to concrete base according to manufacturer's written instructions.

- C. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- D. Remove shipping bolts, blocking, and wedges.

3.03 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "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-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
 - 1. Visual and Mechanical Inspection.
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, and grounding.
 - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - d. Verify the unit is clean.
 - e. Perform specific inspections and mechanical tests recommended by manufacturer.
 - f. Verify that as-left tap connections are as specified.
 - g. Verify the presence of surge arresters and that their ratings are as specified.
 - 2. Electrical Tests:
 - a. Measure resistance at each winding, tap, and bolted connection.
 - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
 - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
 - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.

3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.05 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.06 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

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SECTION 26 24 13
SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Surge protection devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Identification.

1.02 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
 - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail bus configuration, current, and voltage ratings.
 - 3. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 5. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
 - 6. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Delegated Design Submittal:
 - 1. For arc-flash hazard analysis.
 - 2. For arc-flash labels.

1.03 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards.
- C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.07 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Owner's written permission.
 4. Comply with NFPA 70E.

1.08 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.09 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 - 2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.02 SWITCHBOARDS

- A. Acceptable switchboard manufacturers may be ABB, Schnieder Electric, GE, Eaton, Cutler-Hammer, and Siemens
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.
- H. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Panel mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- I. Indoor Enclosures: Steel, NEMA 250, Type 1.
- J. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- K. Barriers: Between adjacent switchboard sections.
- L. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

- M. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- N. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
 - 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, or Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 - 3. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 - 4. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 5. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
 - 6. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- O. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.03 SURGE PROTECTION DEVICES

- A. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
- B. Features and Accessories:
 - 1. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - 2. Indicator light display for protection status.
 - 3. Surge counter.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V.
 - 3. Line to Line: 2000 V for 480Y/277 V.
- E. SCCR: Equal or exceed 100 kA.
- F. Nominal Rating: 20 kA.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - 4. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.

2.05 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
 - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
 - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
 - 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to switchboards.
5. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Install filler plates in unused spaces of panel-mounted sections.
- E. Install overcurrent protective devices, surge protection devices, and instrumentation.
 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Comply with NECA 1.

3.03 CONNECTIONS

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- B. Support and secure conductors within the switchboard according to NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.04 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 3. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections, and prepare reports:

- a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
- b. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.

END OF SECTION 262413

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SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.02 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. MCCB: Molded-case circuit breaker.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 4. Detail bus configuration, current, and voltage ratings.
 - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 6. Include evidence of NRTL listing for series rating of installed devices.
 - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 00 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.09 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than ten days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces .
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. 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.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Surface-mounted, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 2. Height: 84 inches (2.13 m) maximum.
 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 4. Finishes:
 - a. Panels and Trim: Steel or galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
- G. Incoming Mains:
 1. Location: Convertible between top and bottom.
 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.

- b. Bus shall be fully rated the entire length.
- 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
- 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 - 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 5. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type, with a lug on the bar for each pole in the panelboard.
- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - 1. Percentage of Future Space Capacity: Ten percent.
- K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
 - 1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.03 POWER PANELBOARDS

- A. Panelboards: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- C. Mains: as indicated on drawings.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: as indicated on drawings.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Multi-button keypad to access programmable functions and monitored data.
 - d. Integral test jack for connection to portable test set or laptop computer.
 - e. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - 5. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.

- b. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- c. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
- d. Multipole units enclosed in a single housing with a single handle.

2.06 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.07 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:

1. If required, Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box.
- G. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- H. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) or 1 1/4 inch (32 mm) in depth. Orient steel slotted supports vertically.
- I. Install overcurrent protective devices and controllers not already factory installed.
 1. Set field-adjustable, circuit-breaker trip ranges.
 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Make grounding connections. Make connections to grounding electrodes as required.
- K. Install filler plates in unused spaces.
- L. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

1. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
2. Set field-adjustable circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 31 23 00

EARTHWORK

PART 1 - GENERAL

1.01 WORK INCLUDES:

- A. Without limiting the generality thereof, the work under this Section includes the furnishing of all labor, equipment, supplies and materials and the performing of all operations in connection with the following items:
 - 1. Clearing and grubbing, as required.
 - 2. Stripping and stockpiling of topsoil and materials suitable for reuse.
 - 3. Stripping and disposal of existing paving, including base course for utility construction.
 - 4. Excavation and disposal of unsuitable or excess materials, including existing pavements.
 - 5. Excavation, fill, backfill and refill, as indicated or required, including compaction.
 - 6. Rock removal.
 - 7. Rough grading, including compaction of existing materials and granular fills, backfills and refills.
 - 8. Gravel under slabs and footings in the building area as directed, including compaction.
 - 9. Trench excavation, bedding and backfill for all utilities, as directed, including compactions.
 - 10. Dewatering and control of water, as required, for all construction operations.
 - 11. Protection of existing buildings, pavements and utilities to remain.
 - 12. Sheet piling, shoring and bracing of structural and trench excavations.
 - 13. Removal of rock and/or ledge to insure a minimum of 12" cushioning between rock and footing.

1.02 RELATED SECTIONS

- A. Section – 03 31 10 – Concrete Construction
- B. Section – 32 12 00 - Asphalt Paving
- C. Section – 32 92 19 – Seeding
- D. Section – 33 00 00 - Site Utilities, Drainage Structures, Pipe and Fittings
- E. Section - 02281 - Termite Control

1.03 REFERENCES:

- A. Within this section, the Rhode Island Standard Specification for Road and Bridge Construction, latest edition, will be referred to as the "State Standards". All references to measurement and payment are deleted.
- B. AASHTO M-145: The classification of soils and soil - aggregate mixtures for highway construction purposes.

1.04 BUILDING AREA:

- A. The area within limits indicated on the drawings beyond exterior face of the building is herein defined as the building area. All requirements for structure excavation and for fills and refills within the building area shall extend to these lines.

1.05 LAWS AND REGULATIONS:

- A. All work under this Contract shall be accomplished in accordance with regulations of local, county and state and federal agencies and national or utility company standards as they apply.
- B. Requirements of Regulatory Agencies
 - 1. Comply with all municipal, state and federal laws, ordinances, rules, orders and regulations pertaining to the work including all waivers issued to date.
Contractor shall furnish all bonds necessary to get permit for cuts and connections to water services.
 - 2. Comply with applicable requirements of American National Standards Institute (ANSI) Standard A10.6-1969, Safety Requirements for Demolition.
- C. Notify all corporations, companies, individuals or local authorities owning, or having jurisdiction over, utilities running to, through or across areas disturbed by demolition operations. The Contractor shall notify the following prior to beginning operations.
 - 1. Digsafe
 - 2. All utility companies whose services are within 10 feet of the work of this contract.
- D. Comply with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. and the requirements of the Occupational Safety and Health Administration, United Department of Labor.
- E. All protection work and general operations shall be governed by the requirements of OSHA, as most recently amended.
- F. The term "Local Standards" as used herein means the standards of design and construction of the respective municipal department or utility company. Said standards apply except where exceeded by this specification.
- G. Maintain in operating condition all active utilities, sewers, gutters and other drains encountered in the utility installation. Repair to the satisfaction of the Architect and the Owner of the improvement any surface or subsurface improvement damaged during the course of the work (unless such improvement is shown to be abandoned or removed), whether or not such improvement is shown on the Drawings.

1.06 TESTING:

- A. Compaction and soil testing will be performed under provisions of Section 01 45 00.
- B. Ensure compacted fills are tested before proceeding with placement of surface materials.

1.07 SUBMITTALS:

- A. Submit under provisions of Section 01 33 00.
- B. Submit minimum 10 lb. samples of each type of fill material to be used. Forward samples to appointed testing laboratory, packed tightly in containers to prevent contamination.

1.08 PROTECTION:

- A. Protect trees, shrubs, areas to receive planting, rock outcropping, and other features remaining as part of final landscaping.
- B. Protect bench marks, roads, sidewalks, paving, and curbs against damage from equipment and vehicular or foot traffic.
- C. Protect excavations by shoring, bracing, or other methods, as required to prevent cave-ins of loose dirt from failing into excavations.
- D. Protect adjacent, existing utility services that may be damaged by excavation work.
- E. Notify Architect of unexpected sub-surface conditions and discontinue work in area until Architect provides notification to resume work.
- F. Protect bottom of excavations and soil around and beneath foundations from frost.
- G. Grade around excavations to prevent surface water run-off into excavated areas.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Procurement: The contractor shall provide approved general borrow, granular backfill, and fine gravel bedding, as well as graded filter materials for use around both BCCMP combination drains and pours concrete subdrain pipe in the quantities and of the qualities necessary for the proper completion of the work of the contract. The source of all off-site gravel borrow, granular backfill, fine gravel bedding, and graded filter materials shall be the responsibility of the Contractor and shall be subject to the approval of the Architect. The contractor shall obtain the right to procure the materials from the source and furnish the Architect with a duplicate copy of a written agreement with the source from which materials are to be obtained. All resulting excavations shall be left in such satisfactory condition as is required by the agreement with the source.

2.02 FILL MATERIALS: Unless specifically shown otherwise, use the following materials:

- A. "GRADED GRAVEL FILL" (under slab and building area; although a similar graded bank-run gravel may be acceptable) free from loam and other specified undesirable materials, conforming to the following analysis:

<u>Sieve Size</u>	<u>% Passing</u>
3"	100
1-1/2"	75-95
3/4"	60-85
3/8"	45-75
#4	30/65
#40	6-25
#200	0-4

On site material may be used under building areas only after satisfactory test data has been submitted, and only with the Architect's approval.

- B. "Bank Run Gravel" in pipe trenches, around manholes and catch basins, against damproofed foundation walls, where indicated as "gravel fill", and where else shown, free from loam and other specified undesirable material, and conforming to the following analysis:

<u>Sieve Size</u>	<u>% Passing</u>
3"	100
1/2"	50-85
3/8"	50-80
#4	40-75
#40	15-35
#200	0-8

On site material may be used, only after satisfactory test data has been submitted, and only with the Architect's approval.

- C. "Stone" (to stabilize utilities and foundations as necessary and where indicated) conforming to the following analysis:

<u>Sieve Size</u>	<u>% Passing</u>
2-1/4"	100
2"	90-100
1-1/2"	30-55
1-1-1/4"	0-25
1"	1-5
#200	0

- D. "Sand" (if indicated) consisting of clean, inert, hard, durable grains of quartz or other hard durable rock; free from loam or clay, surface coatings and deleterious material; and conforming to the following analysis:

<u>Sieve Size</u>	<u>% Passing</u>
#8	100
#50	25-50
#100	0-10
#200	0-5

- E. Fill Material for Trenches:

Bedding for pipe - "Bank Run Gravel", except with 100% passing 3/4" sieve (stone if unsuitable material is encountered).

Overpipe - Two 6" layers of "Bank Run Gravel", except with 100% passing 3/4" sieve.

Remaining Fill - "Bank Run Gravel"; approved on-site or new material, free from stones over 4" diameter and other specified undesirable materials.

PART 3 - EXECUTION

- 3.01 **CLEARING:** All trees except those indicated to remain, and all brush, stumps, vines, and obstructions within the indicated project limit lines shall be removed entirely unless otherwise indicated. Existing trees to remain shall be protected from injury. No cutting and trimming of trees to remain will be permitted. Trees to remain that may be damaged by construction operations shall be boxed and protected as directed until the project is completed. All stumps shall be removed entirely. Roots shall be grubbed out to at least 18" below subgrades. All timber, brush, refuse, stumps, roots, vines, debris and objectionable matter shall be disposed of off the site. All excavation and depressions resulting from clearing operations shall be filled with approved earth and topsoil, and compacted as specified.
- 3.02 **CONSERVATION TOPSOIL:** Over all areas to be regraded, occupied by new structures or pavements, or disturbed by work operations, topsoil which is determined to be of good quality shall be carefully removed for its full depth, transported and deposited in storage piles, located conveniently to the areas which will subsequently receive topsoil. Topsoil stockpiles shall be kept separate from other excavated materials and free of roots, stones and other undesirable material. The contractor shall take precautions to prevent objectionable materials from becoming mixed with the topsoil either before or after the stripping and stockpiling operations. Stripping operations shall be completed prior to excavation, trenching or grading operations. All stockpiles shall be neatly trimmed and graded without depressions to provide surface drainage as directed by the Architect.
- 3.03 **DISPOSAL OF MATERIAL:** All materials resulting from excavations and classified as earth and approved as suitable by the Architect shall be used for backfilling, filling and such rough grading as is required on the project site. All excavated materials not approved for backfill and fill shall be removed and disposed of off the project site at no additional expense to the Owner.
- 3.04 **SHEATHING, SHEETING, SHORING AND BRACING:**
- A. Excavations shall be sheathed, sheeted, shored and braced by members to prevent danger to persons, structures, adjacent property, caving, erosion, or loss of ground. Special precautionary measures shall be provided to protect existing pavement and structures from damage. Sheeting and timbering shall be left in place until adjacent excavations have been backfilled and compacted, then with the Architect's approval, removed. It shall be the Contractor's responsibility for any damages whatsoever due to the failure of the sheeting, settlement, filled excavations, or the ground adjacent thereto. Care shall be taken to prevent damage to all utilities and services. Any damage to new or existing work occurring through settlement, water or earth pressure, or other causes due to inadequate bracing or other construction operations of the Contractor, shall be satisfactorily repaired. All work done concerning temporary sheeting, shoring, bracing, excavations to extra widths, and either repairs to, or the correction of, damaged work shall be provided by the Contractor at no additional expense to the Owner.
- B. Unless otherwise directed by the Architect, timber sheeting and bracing left in place shall be cut off as follows:
1. Permanent timber sheeting shall be cut off at an elevation 2' below ground level.

2. The bottom portion of temporary timber sheeting (partially withdrawn) shall be cut off at an elevation 2' above the top of pipeline.

3.05 REMOVAL OF WATER AND PROTECTION FROM FLOODING:

- A. The Contractor shall provide, construct and maintain, at no additional expense to the Owner, all pumps, piping, drains, well points, or any other facility for the control and collection of ground water or surface water. The dewatering operations shall insure that all excavations are kept free from water to permit construction work to be performed in the dry. Damage resulting from the failure of dewatering operations or to maintain the area of all structures and work in a suitable dry condition shall be repaired as directed by the Architect at no additional expense to the Owner. The pumping and dewatering operations done in a manner that no loss of ground will result. Precautions shall be taken to protect new and existing work from flooding during storms or from other causes. Pumping shall be continuous where directed by the Architect to protect the work and/or to maintain satisfactory progress. All pipelines or structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected. Water shall not be conducted onto adjacent property. In depressions to be excavated within the building structure limits, dewatering operations necessary for the control and collection of surface and ground water shall be utilized until such time as the permanent gravity subdrainage system is placed in operation to eliminate the possibility of hydrostatic uplift on foundations, floor slabs and all other construction.

3.06 EXCAVATIONS:

- A. Excavate all substances encountered to the limits, lines and grades indicated or specified or as directed by the Architect. Excavations carried below the depths indicated, except as directed by the Architect, shall be refilled to the proper level with thoroughly compacted approved fill, except that in excavations for walls and footings the concrete shall be extended to the bottom of the excavations; all additional work of this nature shall be provided by the Contractor at no additional expense to the Owner. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches and to keep excavations free of standing water and to prevent damage to other structures. Excavations shall extend to a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and inspection. Bottoms of excavations shall be protected from frost: work shall not be placed on frozen ground nor shall work be placed on wet unstable ground. If suitable bearing is not encountered at the depth indicated on the Drawings, the Contractor shall immediately notify the Architect and shall not proceed further until instructions are given. Excavations for interior floor slabs shall be made to provide for gravel fill.
- B. Excavations for other structures: Excavations for subdrainage, underdrains, sanitary, electrical, gas, water and all other utility systems structures shall be made in earth and rock to the indicated depths below the bottoms of foundations and slabs so that the required thickness of compacted gravel courses can be provided.
- C. Trenches:
 1. Trenches shall be of necessary width for the proper laying of the pipe and the banks shall be as nearly vertical as practicable. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. Bell holes

and depressions for joints shall be dug after the trench bottom has been graded, and in order that the pipe rest upon the prepared bottom for as nearly its full length as practicable, shall be only of such length, depth and width as required for properly making the particular type of joint.

2. Except where rock or boulders are encountered, care shall be taken not to excavate below the depths indicated. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe, as determined by the Architect, is encountered in the bottom of the trench, such soil shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, fine gravel or other suitable material, as approved by the Architect.
3. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Special requirements relating to specific utilities are as follows:
 - a. For sanitary sewers, the width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed 8" on either side of the pipe. The width of the trench above that level may be as wide as necessary for sheeting, bracing, and the proper performance of the work. The bottom of the trench shall be rounded so that at least the bottom quadrant of the pipe rests firmly on undisturbed soil for as nearly the full length of the barrel as proper jointing operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipe laying by men skilled in this type of work.
 - b. Except in the cases where water lines must be graded as indicated on the Drawings, to avoid high points and the necessity of placing air release and vacuum valves, trenches for water lines shall be of a depth that will provide a minimum cover over the top of the pipe of 4.5 feet, or as otherwise indicated or directed, from the existing ground surface or the indicated finish grade, whichever is lower, and avoid interference of the water lines with other utilities.
 - c. Excavation and backfill for electrical conduit shall be performed to the details indicated and in accordance with the requirements specified under Division 16 "Electrical". Backfill shall be provided to the depth indicated.

- D. The Contractor is responsible to excavate and dispose off-site (as necessary) all boulders smaller than two (2) cubic feet in size. All boulders larger than two cubic feet in size will be excavated and disposed off-site (as necessary) under the provisions of a unit price as stipulated in the Contract Documents.

3.07 DUST CONTROL: Stockpiled excavated material shall be kept sufficiently damp or treated with calcium chloride to keep dust at a minimum.

3.08 EXCAVATION OF EXISTING PAVEMENT

- A. All areas of existing pavement shall be removed as indicated, as specified and as required for the construction of the work under this contract.

- B. Where excavation of existing roadway pavement outside of property lines is necessary, the existing pavements shall be removed only to the extent required for construction purposes leaving straight vertical edges as approved. After backfill has been placed and approved, the pavements shall be restored to match the existing pavements and in a manner as approved by the controlling authorities.
- C. It shall be the responsibility of the Contractor to obtain all permits, verify existing conditions and perform the work in accordance with the requirements of the controlling authorities. The Contractor shall be responsible for all costs concerning replacement of pavement will be made therefor.
- D. Disposal of asphalt pavement: The general contractor shall be responsible to dispose of excavated asphalt pavement, which is considered a hazardous material, in accordance with all Local, State, and Federal requirements.

3.09 FILLING AND BACKFILLING:

- A. Preparation of Ground Surface for Fill: All unsuitable material within the area upon which fill is to be placed shall be stripped or otherwise removed before the fill is started. In no case will such objectionable material be allowed to remain in or under the fill area. Prepared surfaces shall be wetted and compacted when so directed by the Architect.
- B. Fills or Embankments: Fills shall be constructed at the locations and to the lines and grades indicated and as directed. The completed fill shall correspond to the shapes shown or shall meet the requirements of the particular case. All suitable material removed from the excavations shall be used in forming the necessary fill. All fill materials shall be reasonably free from roots or other organic material, trash, frozen materials, and from all stones having a dimension greater than 4".
 - 1. The materials shall be placed in successive horizontal layers of from 9" to 12" in loose depth as specified or directed by the Architect, for the full width of the cross-section and compacted as hereinafter specified. The top 18" of subgrade fill under paved areas, gravel roadways, and walks shall be non-frost susceptible material.
- C. Filling and Backfilling for Structures
 - 1. Prior to backfilling, all forms shall be removed and the excavations shall be cleaned of all trash and debris.
 - 2. Material for filling and backfilling shall consist of the excavation, sand, gravel or other materials approved by the Architect and/or as specified, and shall be free from refuse, frozen material, vegetable matter and stones larger than 4" in any dimension. Material resulting from rock or ledge excavation shall not be used for filling or backfilling for structures.
 - 3. Fill and backfill shall be placed in horizontal layers, not in excess of 9" in loose thickness, and shall have a moisture content such that the required degree of compaction may be obtained. Each layer shall be compacted by mechanical vibrating rollers or machine tampers or by other suitable and approved compaction requirements to a density that will prevent excessive settlement or shrinkage in accordance with the compaction maintained;

special care shall be taken to prevent any wedging action or eccentric loading upon or against the structures and all slopes bounding such wedging action.

4. During filling and backfilling operations and in the formation of embankments, the Contractor shall be responsible for taking all necessary precautionary measures to assure that the equipment used will not overload the structures during the compaction of fills and backfills.
 5. The indicated thickness of compacted gravel borrow shall be provided beneath all building structure slabs, walls and in allocations so indicated on the Drawings.
- D. Finished Excavation, Fills and Embankments All areas indicated on the plans as well as excavated, filled and transition sections, shall be uniformly and smoothly graded. The finished surface shall be reasonable smooth, compacted, and free from substantial irregularities. The degree of finish shall be that ordinarily obtainable from either blade grader or scraper operations except as otherwise specified. The finished surface shall be not more than 0.15 feet above or below the established grade or approved cross-section. The surface or embankments and other areas to be paved shall not vary more than 0.05 feet from the established grade and approved cross-section.
- E. Preparation of Subgrade for Paved Areas, Gravel Roadways, Walks
1. After the subgrade has been shaped to line, grade and cross-section, it shall be thoroughly compacted. This operation shall include any required reshaping and wetting to obtain proper compaction.
 2. All soft or otherwise unsuitable material shall be removed and replaced with gravel borrow material as specified hereinafter.
 3. All boulders or ledge stone encountered in the excavation shall be removed or broken off to a depth of not less than 6" below the subgrade. The resulting area and all other low sections, holes or depressions shall be brought to the required grade with material approved by the Architect and the entire subgrade shaped to line, grade and cross-section and thoroughly compacted as herein provided. The top 6" of the subgrade shall in every area be compacted to 95% of the maximum dry density obtained at optimum moisture content, as determined by the method specified hereinafter.
- F. Backfilling of Trenches
1. The trenches shall not be backfilled until all repaired pressure tests are performed and until the utilities systems as installed conform to the requirements specified.
 2. All backfill shall be free from vegetable matter, frozen material, refuse and stones larger than 4" in any dimension.
 3. Except as specified otherwise herein, fill and backfill shall be placed in layers not more than 6" thick in loose depth and each layer shall be compacted thoroughly and evenly; the moisture content of the fill material shall be such that the proper compaction will be obtained. Backfilling of trenches shall progress as rapidly as the construction and testing of the work will permit.

4. In backfilling pipe trenches, approved fill shall be compacted in 6" layers in loose depth to the indicated thickness over the top of the pipe; the remainder of the trench shall be backfilled with loose-depth layers of 1' and thoroughly compacted. When trenches have been excavated in areas to be paved, however, the backfill shall be placed and compacted in layers 6" thick in loose depth to the top of the trench.
5. When drainage pipes, utilities, and structures other than building foundations are to be placed in fill, the fill shall be constructed to the finished grades of the fill prior to excavations for the trenches.
6. During the backfilling of all trenches, care shall be taken so that either displacement or injury to pipe lines is avoided.
7. Existing grades that are to remain but which are disturbed by the contractor's operations shall be graded or repaired to match adjacent surfaces. A layer of compacted fine gravel bedding, as specified hereinafter, shall be provided where indicated on the plans.

G. Placement of Backfill adjacent to the retaining walls shall be such that symmetrical backfill loading is maintained. The contractor shall take special care to prevent the occurrence of any wedging action against the retaining wall. During backfilling operations, care shall be exercised so that the use of compaction equipment does not overload the retaining wall. If a power roller is used for compaction, the roller edge must not approach nearer than 4 feet from the face of the wall. The space left shall be machine tamped to the required density as specified hereinafter.

3.10 EXCAVATION AND BACKFILLING FOR ALL OTHER TRADES: Excavation and backfilling for all mechanical, electrical, and such other trades inside and outside of the building shall be performed under this Section unless otherwise specified.

3.11 PROTECTION OF UTILITY LINES Utilities that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation, as well as the utility lines construction during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor in a manner satisfactory to the Architect in no additional expense to the Owner.

3.12 PROTECTION OF SUBGRADE FOR PAVED AREAS AND GRAVEL ROADWAY The finished subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the finish courses are placed. Until the subgrade has been checked for compliance therewith and approved, no finish course material shall be installed thereon. The storage or stockpiling of materials on finished subgrade will not be permitted.

3.13 COMPACTION:

- A. Test: The degree of compaction and the density shall be determined in accordance with Method D of AASHTO test Designation T180-57.
- B. Degree of Compaction:
 1. Each layer of all fills, backfills, or embankments both side and outside and limits of buildings, except backfills and fills adjacent foundations, and walls, and except the top 6" of the subgrade for walks, pavements, footings and walls, shall be compacted to at least 90

percent of maximum dry density at optimum moisture content, as determined by the method given above. The top 6" of subgrade under walks, roadways, pavements, shall be compacted to at least 95 percent of maximum dry density at optimum moisture content, as determined by the method given above. All fills and backfills adjacent to foundations and walls inside the building limits shall be compacted with approved types of equipment to at least 95 percent of maximum dry density at optimum moisture content as determined by the method given above.

2. For trenches, each layer of backfill shall be moistened and compacted to a density at least equal to that of the surrounding undisturbed earth. Such compaction shall be accomplished in such a manner as to permit the rolling and compaction of the filled trench with the adjoining earth to provide the required bearing value. In paved area, rolling and compaction of trenches shall be accomplished so that paving of the area can proceed immediately after backfilling is completed.

C. Compaction Test Results:

1. General Fill: 1 Test for each 2000 s.f. of surface area per lift.
2. Backfill: 1 Test for each 1000 s.f. of surface area per lift.
3. Under Footings: A minimum of six locations prior to footings pours.

- D. Compaction Control: The Architect shall have compaction tests made in accordance with AASHTO Standard Method T147-54 as the work progresses to determine the degree of compaction being obtained by the Contractor. Compaction tests shall be performed in the field for each layer of fill placed and compacted, as directed by the Architect. No succeeding layer of fill shall be placed until approval has been given by the Architect to do so. Any corrective work required as a result of the testing, such as additional compaction or a decrease in the thickness of layers, shall be performed by the Contractor, at no additional expense to the Owner. Compaction control tests will be made at no expense to the Contractor although the Contractor's assistance and cooperation will be required for obtaining samples.

3.14 ROADS TO BE KEPT CLEAN: The Contractor shall be responsible for keeping roads clear of all spillage from trucks when hauling borrow to or hauling surplus materials from the project site.

3.15 WETLAND PROTECTION: The contractor shall be responsible to maintain the wetland protection as shown. The contractor shall be responsible for any damage to any wetland areas.

END OF SECTION

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SECTION 32 31 15

PVC COATED CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. PVC coated galvanized chain link fencing and hardware
- B. Swing gates and hardware

1.02 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.

1.03 QUALIFICATIONS

- A. The manufacturer and installer shall specialize in performing the work of this section with minimum of three years documented experience.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Cyclone fence
- B. Substitutions under provisions of Section 01 60 00.

2.02 MATERIALS

- A. Fabric: Chain link fabric shall be zinc coated per ASTM-392 Class 2. Fabric shall be woven from 9 gauge (coated size) wire in 2" mech. Fabric 60" high and under shall be knuckled at both selvages. Fabric 72" high and over shall be knuckled at one selvege and twisted and barbed at the other selvege.
- B. Line Posts: Line posts shall be 2.375" O.D. standard weight Schedule 40 galvanized pipe with minimum bending strength of 201 pounds under a 6' cantilever load.
- C. Top and Brace Rail: Top and brace rails shall be 1.66" O.D., standard weight Schedule 40 galvanized pipe with minimum vertical bending strength of 202 pounds on 10' span coated with 1.8 ounces of hot dipped zinc in accordance with ASTM-F1083. Top rail couplings 6" minimum in length shall be spaced at maximum 21' centers. Fabric tie wire shall be spaced at 24" maximum centers.
- D. Terminal Posts: All end, corner, and pull posts shall be 2.875" O.D. galvanized standard weight pipe with minimum bending strength of 381 pounds on 6' cantilever load coated with 1.8 ounces of hot dipped zinc in accordance with ASTM-F1083.

Gate posts shall be of the following sizes for single swing gates or one leaf of double gates:

Leaf Width	Gate Post	Lbs/Lin Ft.
Up to 6'	2.875" O.D. Pipe	5.79
Over 6' to 13"	4" O.D. Pipe	9.11
Over 13' to 18'	6-5/8" O.D. Pipe	18.97
Over 18'	8-5/8" O.D. Pipe	28.55

- E. Gate Frames: Gate frames shall be tubular shaped, 1.90" outside diameter with welded or steel fitted corners. Braces, and trusses shall be furnished when necessary.
- F. Tension Bars: One piece lengths equal to full height of fabric with a minimum cross-section of 3/16 inch by 3/4 inch. Provide tension bars for each gate, end, corner and pull posts.
1. Tension bar bands and clips: Heavy pressed steel, or malleable iron.

2.03 GATES

- A. Fabrication: Assemble gate frame by welding connections. Use same fabric as for fence. Install fabric with tension bars at edges. Attach tension bars to gate frame at not more than 15 inch o.c. Attach hardware with rivets or by other means that will provide security against removal or breakdown.
1. Over 10 ft. wide, provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.
2. Bracing: Provide diagonal cross-bracing consisting of 3/8 inch diameter adjustable length truss rods on gates where 4 sided tension rods are not used. Provide frame rigidly without sag or twist.
- B. Gate Hardware: Galvanize per ASTM A153.
1. Hinges: Pressed steel or malleable iron to suit gate size, non-lift-type, offset to permit 180 degree gate opening. Provide one pair of hinges for each leaf. (Up to 12 ft. ht.)
2. Latch: Forked type to permit operation from either side of gate; provide padlocked eye as integral part of latch.
3. Keeper: Provide keeper for gates, which automatically engages the gate leaf and holds it in the open position until manually released.
4. Double Gates: Provide drop rod to hold inactive leaf. Provide pipe in ground to engage the center drop rod. Provide locking device and padlock eyes as an integral part of the latch, requiring one padlock for locking both gate leaves.

2.04 CHAIN LINK FENCING FINISH

- A. Chain link fence, framework and fittings shall be in accordance with US Government Specification RR-F-191 for fusion bonded polyvinyl chloride on galvanized steel.
 - 1. Fabric: Vinyl fusion bonded steel fence fabric over #9 galvanized wire in Black finish; coating thickness to be 7 mils minimum.
 - 2. Frame system: Vinyl fusion bonded, tubular pipe design, galvanized material coated in Black finish; coating thickness to be 10 to 15 mils in thickness.
 - 3. Provide vinyl fusion bonded line, corner and terminal posts, top and bottom rails, brace bars, tension and truss rods, dome caps, etc. as required for a complete system.

2.05 SETTING MATERIALS

- A. Pipe Sleeves: Galvanized "Schedule 40" pipe with I.D. 1/2 inch larger than the O.D. of post, and closed at the bottom with cap or welded plate.
- B. Grout: Quick set POR-ROK expanding concrete as manufactured by Hallemite Manufacturing Company, Cleveland, Ohio or equal.

PART 3 - EXECUTION

3.01 POST INSTALLATION

- A. Layout:
 - 1. End, Corner and Pull Post: Provide at termination and change in horizontal or vertical direction of 30 degrees or more.
 - 2. Line Posts: Space uniformly at approximately 8 feet on center.
 - 3. Fence height: six (6) feet
 - 4. See drawings for width of gates.
- B. Concrete Set Posts: (Corner, End, and Pull Posts) Drill holes (after final grading) in firm, undisturbed or compacted soil. Holes shall have a diameter equal to 4 times the diameter of the post, and depths approximately 6 inches deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
 - 1. Set post not less than 36 inches below when in firm, undisturbed soil.
 - 2. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish tops of footings, and slope or dome to direct water away from posts, except at tennis courts, backstops and walks.
 - 3. Gate posts and hardware: Set keepers, stops, sleeves and other accessories into concrete.
- D. Wall-Set Posts: Vertical posts shall be set into built-in steel pipe sleeves extending into concrete or masonry walls at least 16 inches deep. Fill joint between vertical posts and sleeve.
- E. Check each post for vertical and top alignment and hold in position during placement and finishing operations.

3.02 BRACING AND FRAMING

- A. Top Rails:
 - 1. Random length, averaging not less than 18 feet.
 - 2. Pressed steel sleeve joints, for rigid connections and expansion/contraction.

3.03 FABRIC INSTALLATION

- A. Tension Wire: Provide tension line at bottom of fabric. Install tension wires before stretching fabric and tie to each post with ties or clips. Attach to fabric with hog rings 24 inches o.c.
- B. Fabric: Install fabric on security side of fence, and attach to framework so that fabric remains in tension after pulling force is released. Pull fabric taut and tie to posts, rails, and tension wires. Leave approximately 2 inches between finish grade and bottom selvage, except where bottom of fabric extends into concrete.
 - 1. Ties: Fabric to rails and braces at 24 inches o.c. and line posts at 14 inches o.c.
 - 2. Hot Rings: Attach fabric to tension lines at 24 inches o.c.
- C. Tension Bars: Extend through fabric and secure to gate, end, corner, and pull posts with bands or clips spaced not over 15 inches o.c.

3.04 ACCESSORIES

- A. Tie Wires: Use U-shaped clip or wire, securely fastened around pipe clasping pipe and fabric firmly. Bend ends of wire to minimize to persons or clothing.
- B. Fasteners: Install nuts for tension band and hardware bolts on side of fence opposite fabric side.
- C. Bolts: Used in the construction of fence shall be thoroughly peened.

3.05 GATES

- A. Install gates plumb, level and secure for full opening without interference.
- B. Adjust hardware for smooth operation and lubricate where necessary.

3.06 CLEANING

- A. Clean work under provisions of Section 01 70 00.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Finish grade subsoil
- B. Place, level, and compact topsoil
- C. Fertilizing
- D. Seeding
- E. Maintenance

1.02 RELATED SECTIONS

- A. 31 23 00 - Earthwork

1.03 REFERENCES

- A. FS-O-F-241 - Fertilizers, mixed, commercial

1.04 DEFINITIONS

- A. Weeds: Includes Dandelion, Jemsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perrenial Sorrel, and Brome Grass.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data on seed mixture.

1.06 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.07 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Deliver grass seed mixture in sealed containers, damaged packaging not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis and name of manufacturer.

1.09 MAINTENANCE SERVICE

- A. Furnish service and maintenance of seeded areas until date of Substantial Completion, or Final Acceptance.
- B. Maintenance shall begin immediately after each portion of lawn is planted and shall continue until the work has been officially accepted. All grassed areas shall be kept in a healthy, growing condition by watering, weeding, mowing, rolling, trimming, edging and by any other necessary operations of maintenance.
- C. All areas and parts of areas which fail to show an adequate strand of grass, for any reason whatever, shall be reseeded, repeatedly if necessary, until all areas are covered with an adequate growth of grass. All seeded areas shall be maintained and all reseeding shall be provided at no additional expense to the Owner.
- D. Water shall be furnished by the Contractor as required for the execution of all work under this Section, including maintenance, until the work is completed.
- E. Grass shall be cut at a height of 3 inches.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Grass Seed:

UNIVERSITY OF RHODE ISLAND

Grass Seed Mixture Improved No. 2

	<u>%Purity</u>	<u>%Germ.</u>	<u>%by Wgt.</u>
Creeping red or Chewing's fescue	98	90	40
Baron Kentucky Bluegrass	85	75	20
Improved Kentucky Bluegrass	85	75	20
Improved Perennial Rye95	90	20	

- B. Fertilizer: FS O-F-241, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil to the following proportions: Nitrogen 10 percent, phosphoric acid 6 percent, soluble potash 4 percent.
- C. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.
- D. Stakes: Softwood lumber, chisel pointed.

- E. String: Inorganic fiber.
- F. Edging: Galvanized steel.

PART 3 - EXECUTION

3.01 GRADES: The subgrades of the grassed areas are required to be established 6 inches below finished grade. Grades not otherwise indicated shall be of uniform levels or slope between points where elevations are given or between such points and existing finished grades.

3.02 GRASSING OPERATIONS:

- A. The preparation of grassed areas shall not start until immediately preceding the season for seeding, except that topsoil may be spread at the option of the Contractor provided that it is thoroughly loosened to its full depth and brought to a friable, mellow condition before the seed bed is further prep
- B. The preparation of subgrade soil: The subgrade of all grassed areas is required to be established as called for when subgrade soil is loosened to a depth of 4" and graded to remove all ridges and depressions. The subgrade shall be parallel to the finished grade. All stones over 2" in any dimension, sticks, rubbish or other debris shall be removed. After the preparation of the subgrade soil for lawn areas is finished, no heavy objects except lawn rollers shall be taken over the areas at any time unless the subgrade is adequately protected in a manner approved by the Architect.
- C. Placing topsoil: The topsoil shall be uniformly distributed on the areas designated to be topsoiled and seeded, in sufficient depth to compensate for any shrinkage, so that the average thickness of the compacted topsoil shall be not less than 6". Any irregularities in the surface resulting from topsoiling or other operations thereon shall be corrected to prevent the formation of depressions where water will stand. Topsoil shall not be placed when the topsoil or subgrade is frozen, excessively wet, extremely dry or in a condition which would be detrimental to the topsoiling and seeding operations. Topsoiling shall be performed only when it can be followed within a reasonable time by seeding.
- D. Preparation of seed bed: Before starting work, approved types of equipment shall be on hand and it shall be demonstrated that the application of lime, fertilizer, chlordane and seed will be made at the specified rates.
 - a. Fine grading: The surface shall be brought to the required finished grades, free of ridges and depressions, through successive stages of light rolling, fine grading and raking operations. The surfaces shall be cleared of all stones, roots, stumps, weeds, objects larger than 1" in diameter and other material which would be a hindrance to planting operations or to plant growth.
 - b. Application of lime, chlordane and fertilizer shall be completed as specified below. Quantities given are minimum. Each material shall be thoroughly incorporated in the top 4" of the surface. Application shall be made at least 2 days before seed is sown and the area shall be thoroughly watered unless same is accomplished by rainfall.

(1) Lime - 100 pounds per 1,000 square feet.

- (2) Fertilizer - 30 pounds per 1,000 square feet.
 - (3) Superphosphate - 15 pounds per 1,000 square feet.
 - c. Finish grading shall be obtained by removing high and low spots and removing stones and objectionable objects from the surface to produce a firm level finely pulverized seed bed.
 - d. Sowing seed: No seeding shall be permitted after a rain unless the surface of the ground is loosened, or when the velocity of the wind exceeds a gentle breeze of about 5 miles per hour. Prior to seeding a light application of fertilizer (10-10-10) shall be applied at the rate of 5 to 10 pounds for each 1000 feet. Seed shall be sown openly at the rate of 5 pounds per 1,000 square feet and lightly raked into the surface to a depth of 1/4". Extreme care shall be exercised during the seeding and raking so that no change in grade is made and so that the seed is not raked from one spot to another. The area shall then be lightly rolled and thoroughly watered with a fine spray.
- 3.03 PROTECTION: All seeded areas shall be adequately protected at all times against traffic, trespassing or other operations and from damage of any kind by erecting barricades or by other approved methods. The contractor shall repair all damage to seeded areas, at no additional expense to the Owner.
- 3.04 PLANTING SEASON: The season for the planting of lawns shall be from April 1 to June 15, and August 15 to September 25, except as such times therein as the Architect may consider inadvisable because of weather or other conditions and except as otherwise herein specified. In the event that seasonal and other conditions permit and upon approval of the Architect, seeding may start earlier and shall be started on all areas during the first planting season after the subgrade has been established. The preparation of lawn areas may begin prior to the specified planting season provided the subgrade has been established and approved, and provided that, in the judgment of the Architect, the general construction work is sufficiently advanced.
- A. Attention is called to the fact that certain grading operations are required to be done under Section 31 23 00 - Earthwork, before the work under this section can proceed. These operations include all cutting, filling, backfilling and grading necessary to bring all subgrades for lawn areas to the required depth below proposed final grades.
 - a. Subgrade elevations shall be understood to be at the specified depths below the proposed final grades shown on the Drawings or specifications.
 - b. Finished grades shall be understood to be proposed final grades shown on the Drawings or specifications. Where final grades are not indicated finished grades shall be of uniform level of slope between points for which elevations are given or between such points and existing grades.
- 3.05 CLEAN-UP: The Contractor shall leave each area neat and clean. Any paved area over which hauling operations are conducted shall be kept clean and any topsoil or other material which may be brought upon paved surfaces shall be promptly removed.
- 3.06 FINAL INSPECTION AND ACCEPTANCE: The work of grassed areas will be subject to the acceptance of the Architect upon the completion of all work of this Section, including maintenance.

- 3.07 SLOPE EROSION PROTECTION: All grassed slopes 2:1 or greater shall be covered with Dutch type burlap material after seeding operations are completed. Burlap shall be secured to ground with wood pegs 5'-0" o.c. each direction.

END OF SECTION